Editorial

SOUND waves, and audio in general, are big news and big business these days. Like an octopus, feelers are spreading out into all manner of unexpected fields. Reports and magazine articles debate frequency range for reproducers, distortion, loud speaker design, gramophone records, broadcasting, physical and bio-acoustics, two and three dimensional sound for outdoor, theatre and home use and so on.

Even journals dealing mainly with world trends and social reactions have devoted space to its growth and the money to be made from it.

Theatre interests are paying as much attention to sound systems as to wide screen and 3-D presentation—they regard the extension of sight and sound facilities as completely complementary.

Our contentment with somewhat primitive sound for radio reception may soon receive a series of shocks. Investigation and experience seem to indicate that we have been conditioned rather than contented.

The merciless chopping of radio reproduction by the average radio tuner to a few thousand cycles undoubtedly has had much to do with this. Short-wave reception, which few ever bother about, doesn't go hand in hand with good quality local receivers for commercial production. Gramophone records until recently have been handicapped by high surface noise and distortion. Now that better records are obtainable, the kick-back on radio reception seems certain.

To a large extent, this operation can be seen here in Australia. The great increase in the number of concert-goers recruited from listening ranks coincides with the sale of radiograms, which, with mantel sets, now comprise the two major divisions in listening mediums. So much so that the once-popular console radio set has virtually disappeared. Power lines throughout the country have removed the limitations of battery sets for many.

Sooner or later, this trend must have further impact. On a long term basis it must lead to better broadcasting and reception, wider range, lower distortion and better sound distribution. The use of VHF for TV sound, possibly with FM, will focus attention on a similar source for broadcasting. Ten years ago such a move was before its time. Today we can see it looming again as a possible answer.

Scientists and research teams are studying our susceptibility to sound, to find whether they can account for human reactions not always consistent with improvements in equipment. They are learning much more about the sensory system and the brain and their enquiries are covering a wide field.

It seems that much more than mere technical problems are involved. The new reference level for sound will, I believe, lie in the integration of many factors which make for realism. Some of the most important of them may emerge, not from the study of the equipment, but of the man.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

A skilled workman is shown hand-finishing a die block, off which about 1000 blades will be pressed for use in high-speed aircraft jet motors. The metal is Nimonic 80 steel. See also picture on page 3.

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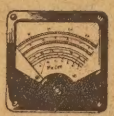
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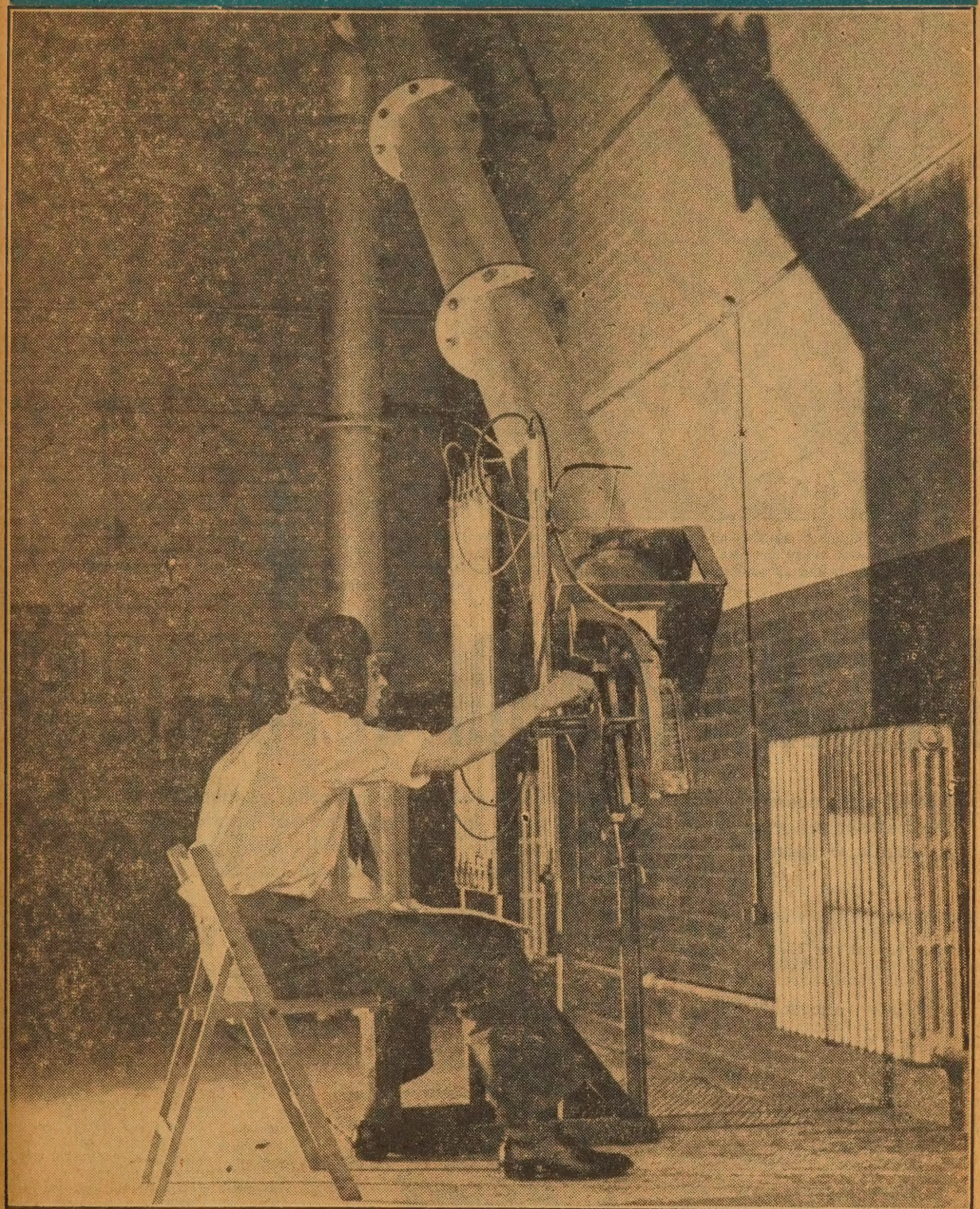
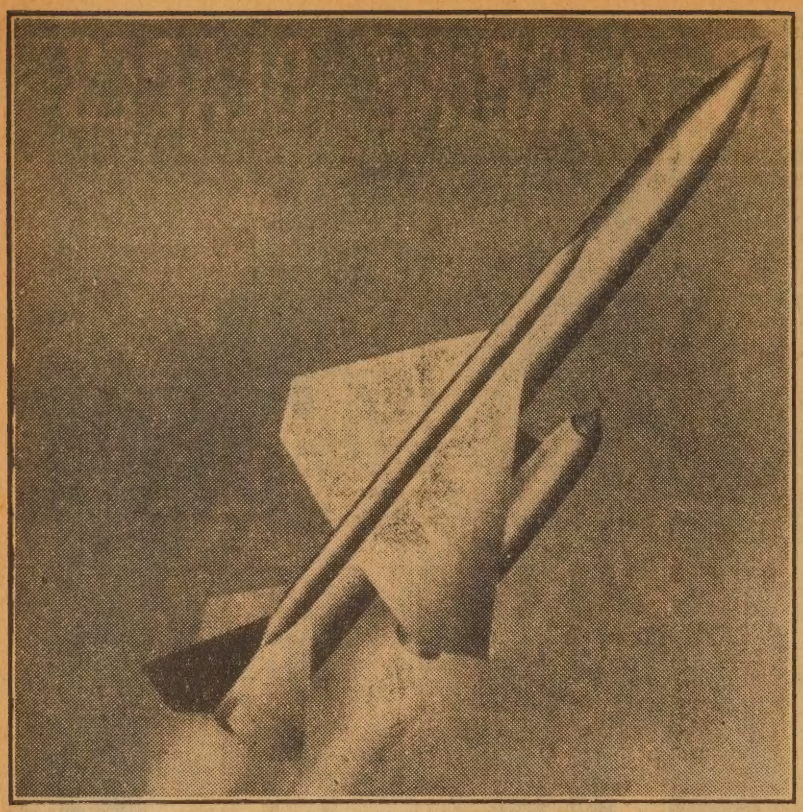
TESTING GAS TURBINE BLADES



The performance of a modern jet engine—or gas turbine—depends a great deal on the design and precision of the turbine blades. This picture shows a test set-up at the Pystock works of the British National Gas Turbine Establishment. In this apparatus, the blades are tested to find how much they deflect the air and what losses occur as it goes through the blades at a speed of 1000 feet per second.



An official U.S. Air Force drawing of the "Bormec" pilotless interceptor, designed to track and catch enemy bombers. Under development by Boeing, Bormac is powered by a rocket motor and an auxiliary ramjet. Top speed is said to exceed 1500mph.

DANGER—BEWARE OF MISSILES!

Recent announcements from the British Ministry of Supply and other sources have emphasised the tremendous progress currently being made in the development of remotely controlled and automatic weapons. This graphic story, published originally in the Baltimore Sun, describes current American tests at the research centre in Florida.

by Howard Norton

A THUNDEROUS voice from the clear, blue sky of a Florida morning rattles the bridge windows of a coastal freighter wallowing methodically northward in the Gulf Stream.

"Attention! Attention!" it roars. "You are in a danger area! You are in a danger area!"

The heads of startled crewmen pop out of companionways and peer into the sun. And on the bridge the skipper shades his eyes to read the air force markings on a low-flying C-47 circling above him.

"Change course to ——," the aerial voice roars on. "Change course ——"

The skipper nods and gives a wave of recognition. And slowly the freighter's bow swings to the new bearing.

The air force "polly" plane dips its wing and buzzes off toward the horizon to shout its warning through compressed-air-boosted amplifiers to another ship.

And southeastward for hundreds of miles at that very moment the same scene is being repeated by other "polly" planes, roaring orders to fishing boats, yachts and every other surface craft they find inside the boundaries of a path of water stretching from the Florida coast to Puerto Rico.

Focal point of all this activity is barren, sandy Cape Canaveral, jutting out of Florida's east coast midway between Jacksonville and Miami.

There one of the nation's new pilotless bombers is poised on a ramp ready to try its wings over the world's longest missile-testing range.

Its nose is tilted upward and aimed along a path that would take it over Grand Bahama Island, and on past Eleuthera, San Salvador, Mayaguana, Grand Turk, the Dominican Republic and Puerto Rico.

Down across this string of islands, little groups of men in air force fatigues huddle over the controls of radar and other complicated tracking and recording instruments.

In a heavy concrete pillbox, half-buried in the sand behind the launching ramp, another group tensely awaits the signal that the range is clear, and the order to press the blast-off button.

TENSE WAIT

And a mile behind the launching site, in a long, low concrete structure topped with radar antenna and packed with intricate electronic machinery, the men who will command the test are standing ready.

Slowly, the messages come in from the "down-range" stations. Section after section reports clear. But still the huge winged missile waits.

The whole range has got to be completely open. No chances are to be taken. A single tiny yacht, blundering onto the range hundreds of miles away at the last minute, could cancel all the hours of preparation.

The minutes drag on. At last the clearing job is finished. The "polly" planes move off and circle at a safe distance.

And finally, the spine-tingling moment comes—one minute to firing time—and the count begins:

"X-minus 60, X-minus 59, X-minus 58 . . ."

Will the missile topple and blow?

The long minute ends.

There is a puff of red, a mushroom of dust, a roar, and the pilotless craft rises slowly, leaving a trail of heavy smoke.

Then it picks up speed quickly—and suddenly it is gone.

At the launching site, instruments whir and cameras grind.

Hundreds of miles down along the islands, observers stand ready behind navy-type gun directors, with antennas mounted on them.

And inside the speeding missile a maze of automatic instruments sends out a rapid flow of signals—telling temperature, speed, fuel consumption and the stresses and strains of its complicated parts in the process of high-speed flight.

Back at "the brain"—the central control building at Cape Canaveral

—these messages are flowing into a big black box with 170,000-dollars' worth of schooling crammed into its steel skull.

All in a matter of microseconds (a microsecond is a millionth of one second) the signals from the speeding missile are jumbled around a massive circuit of electronic tubes and relays and transferred onto the plotting boards in the form of an inked line, drawn by an automatic pen.

As the missile flashes from island to island, new sets of instruments pick it up and track it to the horizon and beyond.

At the starting base, the "in-flight safety officer" watches its progress across a map where its every movement is shown instantly and recorded permanently.

Should it veer to the right or left, or its steering and control instruments fail, he has but to press a button and the craft destroys itself.

But there is no failure this time.

Straight as an arrow it screams toward its destination.

Then abruptly, the flight is over.

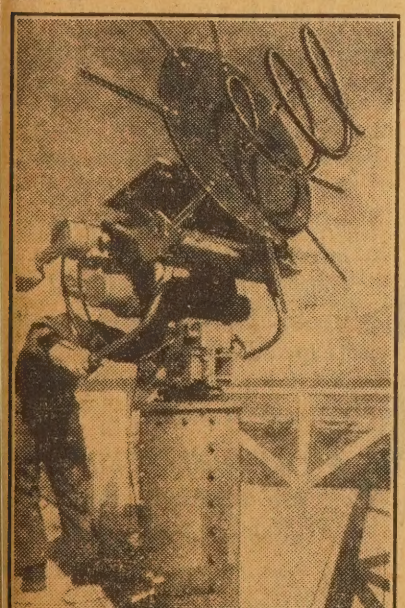
DESTROYS ITSELF

In the darkened control centre somebody puts his finger on a button. And the sleek, shiny missile—hundreds of miles away—wavers in its course.

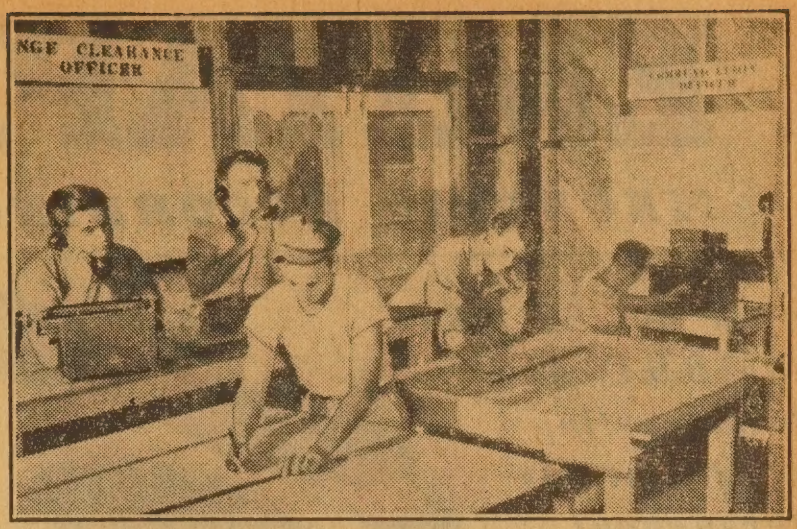
It noses downward and dives into the seas.

All up and down the thousand miles of island-studded testing range, the crewmen in the observation and control stations push back their chairs and stretch their cramped limbs.

And as they light up their cigarettes or reach for cups of coffee, the thunderous voices of the "polly" planes reverberate again far out over the sea:



Special radio aerials like this one track the missile through its flight and feed back to recording tapes the telemetered information from the missile about its speed, height, fuel consumption, stresses and so on.



At the Cape Canaveral launching area in Florida, "missiliers" check reports from range-clearing planes and boats before giving the all-clear to launch.

"All clear! All clear!" they announce to the detouring ships. "You may resume course!"

This drama has been going on, at a gradually accelerating pace, since 1950, when the air force missile test centre was opened only a few miles from Cocoa Beach, Florida.

Under the command of Maj. Gen. William L. Richardson — the air force's pioneer in the art of push-button warfare — this testing centre and its long oversea range is being used by all the armed services to try out the guided missiles of the future.

And these missiles are improving so fast, General Richardson says, that the air force is having a hard time keeping its testing apparatus abreast of them.

Already they can fly hundreds of miles at supersonic speeds, and keep the human pilot—back at home base—fully informed of how and what they are doing.

EXCELLENT CONTROL

The guided missile pilot, even today—with perfection still far in the future—can sit at a desk and put his craft through complicated manoeuvres and send it plunging down on a target with an accuracy that the air force doesn't care to describe with more than a pleased grin.

The so-called short-range missiles—the kind that fly 150 to 200 miles—are no longer much of a problem. They can be made to do just about anything required of them.

And even the long-range missiles—the kind the air force hopes, and expects, will replace piloted bombers in intercontinental attacks some day—are well out of the dream stage.

And when the intercontinental pilotless bomber is ready to fly, the Cape Canaveral testing range will offer plenty of room to fly it.

As of now, the range is only about 1000 miles long. It runs from the cape to Puerto Rico.

But already work is far advanced on a project that will, in effect, double its length.

The project is a landing strip being laid at the cape which will make it possible to send the pilotless craft out on a 2000-mile round trip to Puerto Rico and back, and to land them safely, with instruments intact, when they return.

And if the day comes when 2000 miles isn't far enough, the Cape Canaveral testing range can be stretched out almost indefinitely.

From the cape, it's a 10,000-mile bee-line flight to the South Pole with nothing but open water and a few isolated islands in between.

And if the 10,000-mile flight to the pole still isn't enough, the pilotless craft of the future could be turned around and brought back over the same route, for a total hop of 20,000 miles—nearly the equivalent of a flight around the world!

But nobody here thinks it will ever be necessary to send any pilotless missile that far.

General Richardson puts it this way:

"If we can make them fly right for a thousand miles, then we can take it for granted they'll do all right from there on as far as their fuel will carry them.

"However, for missiles with greater range it will be necessary to have only a few check points beyond the 1000-mile point."

The big job now, he says, is to perfect a foolproof system of guiding them.

LIKE SMALL PLANE

In its present form, the typical guided missile looks like a half-size, streamlined, swept-wing jet bomber.

And as produced at present it may cost as much as 10 times more than a conventional block-buster bomb.

But, says General Richardson, the guided missile is likely to be something like 100 times more accurate than the old-type bomb. And that makes it cheaper to use in knocking out targets.

But the saving doesn't stop there.

Because nobody has to fly in it, it will save lives.

Because smaller quantities of missiles are needed when they are guided to their targets, it will save materials.

And because the production job is likely to be smaller, a smaller proportion of the nation's manpower will be tied up in it.

And since guided missiles do not require long, heavy runways, the cost of launching bases will be much reduced from the days of the big bombers.

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Also, because guided missiles don't return once they are fired, it won't be necessary to build and maintain big, complicated repair and maintenance bases.

But the guided missile also has its shortcomings, and it is to counter these shortcomings that the air force has set up the testing range on this tropical coast.

One weakness is that the enemy can jam the radio signals that guide the missile and thus divert it from its target.

But the experts here believe they can solve that problem in at least two ways.

STELLAR "FIX"

First, it is no secret that there has been considerable progress in developing a system of tying the missile's controls by an optical "fix" upon a selected star.

The enemy would be powerless to alter any such astronomically guided course.

Second, the missile's course can be calculated in advance, and set down on a roll of perforated paper, like an old-fashioned player piano roll. This is inserted in the mechanism of the craft and played off during flight, the course and altitude changing as the perforated roll gives the command.

Though the air force operates the Florida long-range missile testing project, it is here for all the services to use.

But since pilotless missiles are still in the development stage practically all the current test flying is being done by the civilian manufacturers who produce them.

The air force furnishes the range, the testing apparatus and the experienced personnel to operate it. But the data, once compiled, goes to the manufacturer to help him improve his product.

Baltimore's own Glenn L. Martin Company is the pioneer in the field, and one of the leaders.

The first really successful pilotless bomber unveiled by the air force—the B-61, better known as "the Matador" — was a Martin product and is being turned out in quantity at the Middle River Martin plant.

MUCH TO LEARN

Charles E. Hollyday, formerly of Baltimore, puts it this way:

"The guided missile business is like the aeroplane business was in the first world war.

"It's an unknown field.

"We have nothing to go on—no set of proven facts.

"We just have to send them up and see what happens, and then try it a different way the next time."

Not all the Baltimoreans here are with the Martin Company.

The civilian chief of operations at the Cape Canaveral launching site is Charles A. Thoman, 42, a graduate of Baltimore City College.

Thoman supervises all the tests, and probably knows as much about what pilotless aircraft can do as any other man alive.

"The horizons are unlimited, from what we see here every day," he declares. And by that, he adds, he does not mean exclusively the military horizons.

Thoman sees great things for pilotless aircraft in civilian fields.

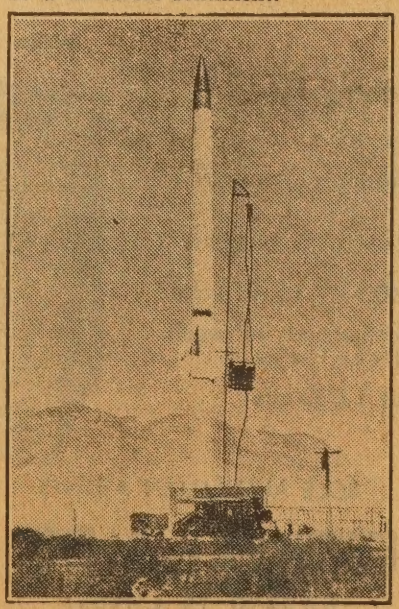
"Within the next 10 years," he predicts, "we'll be able to transport mail and cargo from city to city at speeds beyond the capability of aircraft with humans at the controls."

Developments like that, he thinks, will represent a big dividend on the investment the armed services are pouring into the project.

Thoman has been at the Cape Canaveral base for 2½ years.

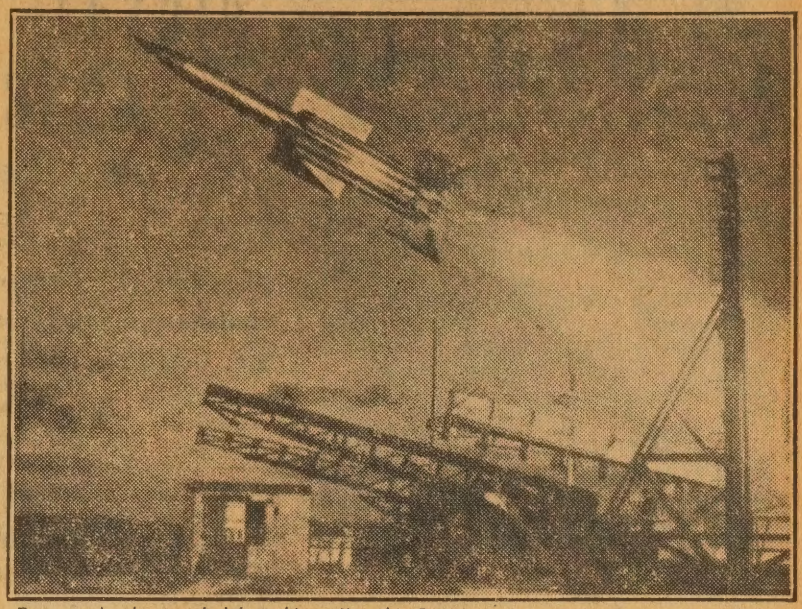
Thoman's enthusiasm for the aeroplanes that fly without crews is matched by the feeling of the Air Force men who are stationed here to learn the art of handling them.

Airman (third class) Edward B. Christie, 21, voices what appears to be a universal sentiment:



A US Navy "Viking" rocket at the moment of take-off. These rockets have reached heights of over 130 miles and bettered 4000 mph.—indications of what rocket power can achieve even now.

A BRITISH ROCKET TAKES OFF



From a closely guarded launching site, this British rocket takes off on a test flight. Four booster rockets, which help launch it at high speed, drop off automatically when expended, leaving the rocket's own motor to carry on.

"I like them," he says, "because nobody gets killed in them."

And a good word for the safety record of the guided missile program is also put in by Airman (second class) John H. Smith, 21, who is stationed here with his twin brother, Joseph S. Smith.

John is stationed at the dispensary at Cape Canaveral, and Joe is first-aid man on the ambulance that stands by in case of accident when the missiles are fired.

"We don't get much business," says John.

"There's never been any big accident.

"I guess those things cost so much they can't afford accidents."

The launching and firing of guided missiles on instrumental test flights is one of the most complicated operations on earth.

THOUSANDS OF MEN

It requires the work of thousands of men and the use of tons of ground equipment every time one of the pilotless craft takes to the air.

One whole building full of instruments, for example, does nothing but spot sources of radio interference that might cause the missiles to go wrong.

And when such interference is spotted, this building full of equipment and its staff concentrates on the job of switching to a frequency where such interference does not exist. And the flight goes ahead on schedule.

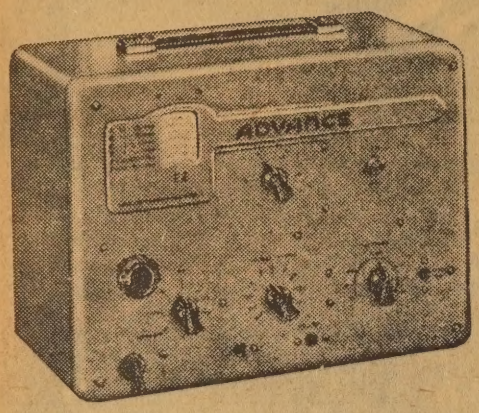
At the Florida testing site, most of the troublesome interference comes from Cuban television and radio signals.

The Air Force missile test centre is also the nation's first training ground for the "missiliers" of the future.

Two guided missile squadrons — the 1st and 69th Pilotless Bomber Squadrons — are now training here.

What they do and how they do it are among the Air Force's most closely guarded secrets.

Advance SIGNAL GENERATORS



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R.F. Output:	1 uV to 100mV, continuously variable through 75 ohm matched transmission line. A steady output of 1 volt is also provided through a separate socket. Using the termination pad, output impedances of 37 ohms, 10 ohms, or 10 ohms through a standard all-wave dummy aerial may be obtained.
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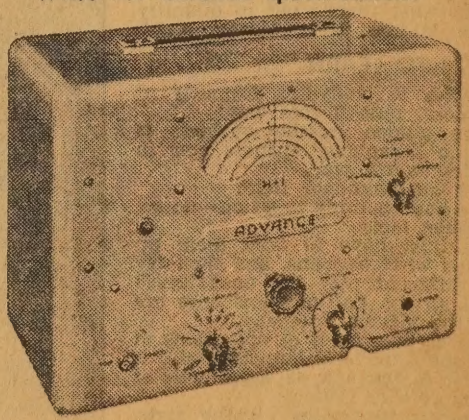
A.F. GENERATOR TYPE H1

Range:	15 c/s to 50,000 c/s
Accuracy:	Frequency calibration plus minus 1% or plus minus 1 c/s
Output:	Sine wave—200 uV to 20 volts plus minus 1 db Square wave—400 uV to 40 volts
Rate of rise of square wave:	Less than 3 microseconds to reach 90% of peak value at 10 Kc/s
Distortion:	Less than 1% at 1,000 c/s



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MODEL CARS DRIVE THEMSELVES

The gradual introduction throughout the world of long-distance express highways is setting the stage for tomorrow's car—one that will steer itself and brake automatically to a stop when the road ahead is blocked by another vehicle.

THAT such a device is desirable—and feasible—is becoming obvious to those who drive regularly on the express highways.

Drivers using them must maintain their speed within narrow limits to avoid overtaking vehicles ahead, or embarrassing those behind. They must often stick to certain lanes and are almost as closely regimented as trains on a railway track.

Fatigue and boredom is a very real problem. Drivers become listless or actually doze at the wheel, and serious accidents are inevitable. In bad weather, lack of visibility introduces a new hazard.

The ideal is obvious enough. The driver should be able to pilot his car into a specified traffic lane and set controls which will keep the car in the lane, hold the required speed and brake automatically if there are vehicles or obstructions in the path.

It would function like an aeroplane's auto pilot and involve a combination of electronic equipment using the new transistors, power steering and some kind of a track for the equipment to follow.

WORKING MODEL

In the RCA Laboratories at Princeton, New Jersey, a couple of workers under Dr. Zworykin have laid out a "highway" loop on which travel two gaily-colored miniature cars—the type children like so much to ride in.

But a diminutive store dummy rides in the red car, lazily reading the paper and enjoying a cigarette. Powered by its own electric motor, the car rolls smoothly around the track.

Demonstrating how the automatic control works, Dr. Zworykin parked the second car in a particular spot on the model highway, then nonchalantly turned his back. The little red car simply veered around the parked blue car, then returned to its former track. When it came around again, the same thing happened.

But the moment the blue car was moved off the highway, the red car went straight through.

In another test, the blue car was dropped across the track where there was no provision for a detour. This time the red car slowed of its own accord and braked to a standstill a car's length from the obstruction.

The explanation for the little car's uncanny behavior lay partly in a length of fine wire pinned to the "road" surface and defining the traffic lane. Where the car veered in the first instance, the engineers had provided a bypass track by looping a half-moon of wire out from the regular lane.

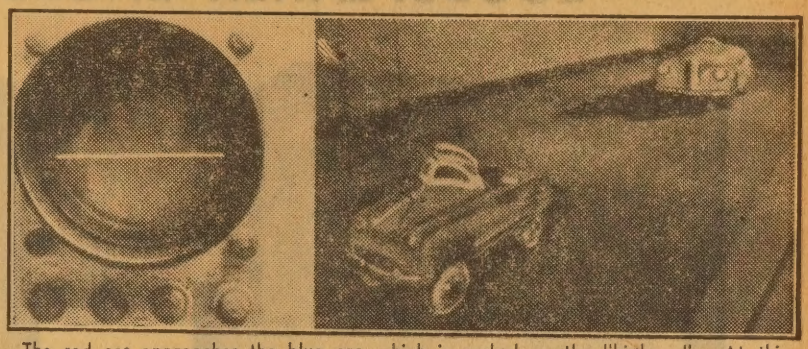
The cars had no direct connection to the wire. It merely provides a metallic reference path for the guiding circuits which keep the cars straddled over the wire.

The wire itself carries current which is tapped off the laboratory's regular high frequency power supply. Magnetic circuits near the front wheels "sense" the strength of the magnetic field surrounding the wire and feed a sample to control circuits within the car.

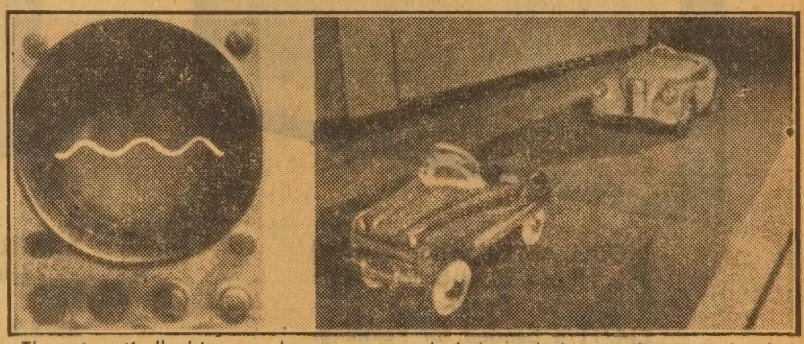
These operate servo mechanisms attached to the steering which keep the car centrally over the wire, irrespective of twists and turns.

The steel body of the car, meanwhile, disturbs the magnetic field around the wire and produces disturbance signals which can be detected back along the wire. That is how circuits in the little red car "sensed" the blue car ahead and caused it to stop or to select an alternative path if there happened to be one available.

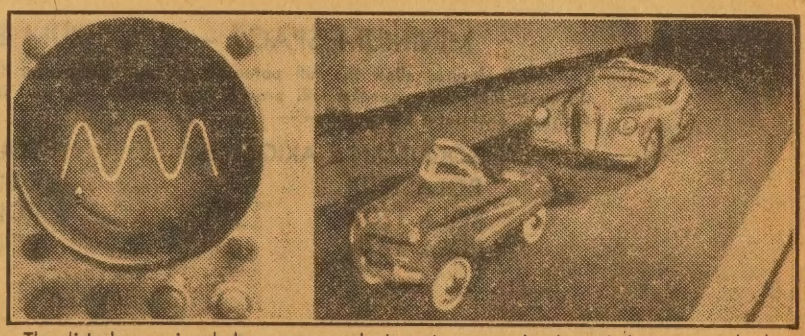
Dr. Zworykin agrees that the cars are only toys and the highway is merely a track on the laboratory floor. But there is no valid reason why the idea cannot be scaled up for full-sized cars; why the simple strand of wire cannot become a buried cable; why the simple bypass loop cannot be extended into a pattern of alternate lanes, loops and crossings.



The red car approaches the blue car, which is parked on the "highway". At this stage the circuits have not yet sensed the disturbance created by the parked car.



The automatically-driven car has now approached the parked car and, as revealed by the oscilloscope, has sensed the presence of the obstruction. It slows down.



The disturbance signals have now reached maximum amplitude and the rear car brakes to a complete stop. Had a bypass loop been available, it would have detoured.

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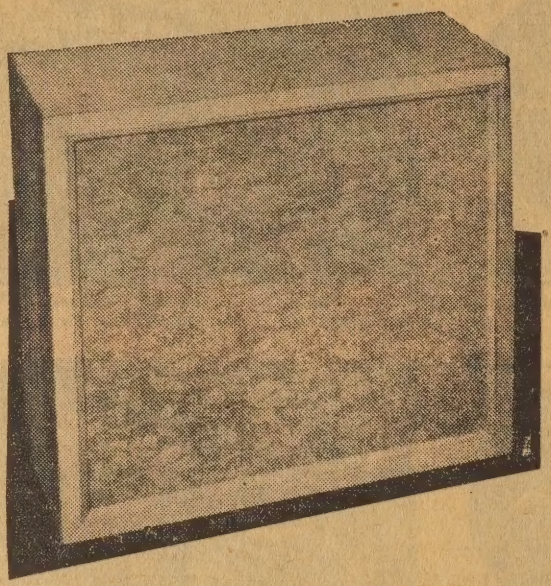

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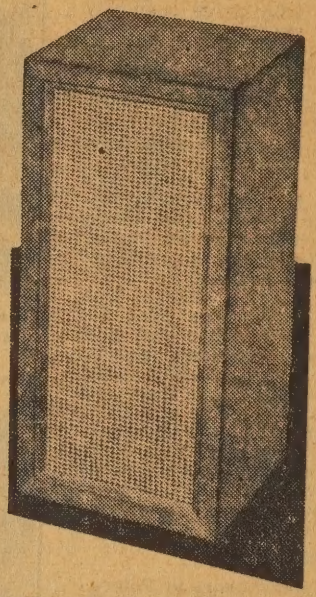

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PLANES GET A CHEMICAL BATH

A chemical bathtub big enough to dunk-like-a-doughnut the largest airframe part ever built is now in operation at Lockheed Aircraft Corporation. It uses the new chromodise - iridite method to prepare aluminium for painting.

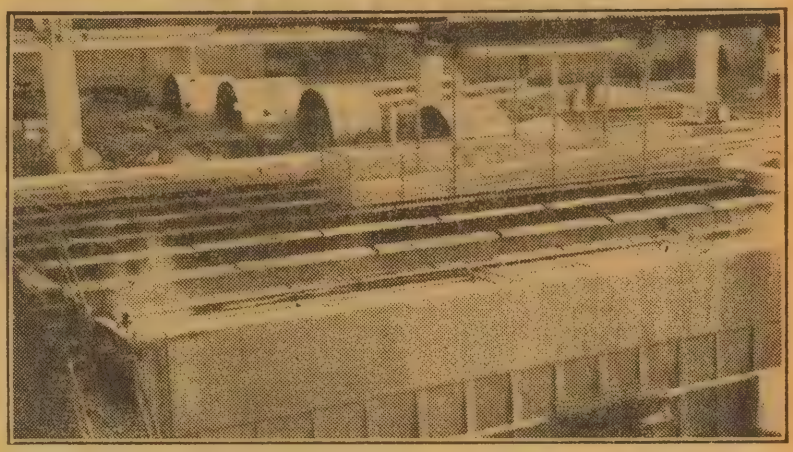
LOCKHEED engineers report that the new "iridite" process, which deposits an iridescent chemical film on the part by simple immersion is much more efficient and economical than the anodize method which oxidised the aluminium surface through electrolysis.

Use of the new system has cut time for the processing procedure in half. Formerly a 1½-hour operation, the entire job can now be done in 47 minutes.

Engineers listed these specific advantages of the iridite process:

(1) It provides a better base for paint adhesion. An iridite surface is tough and pliable, whereas anodised surfaces are hard and brittle.

(2) Iridite can be applied on parts having dissimilar metals, whereas anodising requires that no metal other than aluminium be placed in the tank solution.



Installed by the Lockheed Aircraft Corporation, these huge tanks will take the largest airframe components.

(3) The iridite system does not require special racks and procedures to provide electrical contact for each individual part as in the anodising method. Part losses due to poor electrical contact are thus eliminated.

(4) Very little, if any, maintenance cost will be required for servicing baskets used with iridite.

The following operations will be performed by individual tanks, each of which is 52ft long, 12ft deep and 4ft wide: Hot soap cleansing; acid etch to prepare parts for iridite; an iridite tank; one chromic acid tank for treating alclad aluminium parts to be painted; two spray rinse and two dunk rinse tanks; and one tank for drying.

Each tank has an 18,000-gallon capacity. Special demineralisation apparatus is installed which can demineralise 15,000 gallons of water per day.

The over-all procedure for processing aluminium parts, through the chromodise and iridite solutions, involves four separate sequences.

- Sequence No. 1, for the chromodising process, is used for a specified range of alloys and assemblies. It involves: Immersion for 5-20 minutes in the alkaline cleaning tank; 2-minute cold water spray and rinse; chromodise immersion for 2-5 minutes; cold water spray rinse for at least 2 minutes; 1-minute immersion in hot water rinse; hot air drying at a temperature of 210 degrees.

- Sequence No. 2, for the chromodising process, is used for treating electrically welded assemblies. The significant difference from No. 1 is that parts are not processed through the hot soap or alkaline cleaning tank, thereby avoiding the danger of entrapping the cleaning solution.

- Sequence No. 3, for the iridite process, is used on all bare aluminium alloys, machine parts and extrusions: Immersion for 5-20 minutes in the alkaline cleaning tank; 2-minute cold water rinse; 1-2 minutes cold water spray; 3-10 minutes immersion in the etch tank; cold water spray for 2-3 minutes; 3-5 minutes immersion in the iridite No. 14; cold water spray for 2-3 minutes; 1-minute hot water rinse; hot air dry at maximum temperature of 210 degrees Fahrenheit.

- Sequence No. 4 is used on assemblies where there is danger of entrapping the alkaline cleaner and acid etch chemicals. Parts are therefore not processed through tanks containing these solutions.

MAKING THE WEATHER TO ORDER

Rubber hose and tires that splinter like glass, oil that can be chipped with an ice-pick, a B-17 that shrinks two-tenths of a foot under flight conditions—these are a few of the strange phenomena encountered by air force scientists conducting sub-zero tests in a gigantic climatic hangar at the Elgin Field, Florida, USA.

THE 7-million dollar and 2,900,000 cubic-foot all-weather chamber was developed by the Air Proving Grounds Command to simulate all the atmospheric and environmental conditions that planes and men can be expected to meet.

To meet air force specifications, all equipment and aircraft must perform satisfactorily under a variety of artificially created conditions ranging from temperatures of minus 65 to 160 degrees Fahrenheit and up to altitudes of 80,000 feet.

Tests in the huge hangar, believed to be the world's largest all-weather chamber, have shown that equipment problems multiply as the temperature falls. Fuels do not vaporise sufficiently to start engines; bombers, like the B-17, are two-tenths of a foot shorter at minus 65 degrees than they are at plus 75 degrees F; Hydraulic systems, guns, air systems and radar installations all perform erratically at subzero temperatures. To aggravate the problem, maintenance time doubles and even triples.

To find out why such things occur, air force weather makers whip up 100-mile-an-hour winds, combining the wind storm with combinations of sleet, snow, rain or sand.

Ordinarily the task of correlating the vast amount of data uncovered would be a major job. But engineers from Minneapolis-Honeywell's industrial division devised a complex electronic-recording system that easily handles this problem. The system utilises some 100 indicating and recording instruments.

To add further realism to the tests, all operating characteristics of the aircraft are tested under these various conditions. Engines are run, guns and rockets fired, landing gear raised or lowered and even bomb racks tested by dropping dummy bombs into a special nine-foot pit.

In addition, there are facilities for road testing motorised ground vehicles and small arms.

The laboratory-like controlled tests, in the case of aircraft, eliminate hundreds of hours of expensive flight-test time and provide more accurate, complete data than could be gathered by conventional in-flight testing methods.

Air force engineers explain that it costs more than 2-million dollars to take a single, medium-class bomber to Alaska for cold-weather testing. In contrast, it costs only 478,775 dollars to test this bomber in the all-weather hangar and, in addition to the bomber, some 21 additional aircraft and 50-odd pieces of military equipment can be simultaneously tested.

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PURITY ISN'T ALWAYS THE GOAL

Sir Galahad would be in for a joust with science, were he around today. Latest word from the scientists is that purity, Galahad's virtue, is taking a back seat to impurity. Only in small amounts, though . . .

By J. D. MORTON

WHILE scientists for centuries have devoted their best efforts to producing materials without flaws or impurities, they now are finding that minute amounts of impurities properly placed in many materials prove to be controlling factors in electrical, optical, and strength characteristics.

An indication of the importance of this widening investigation was the three-day symposium on impurity phenomena held recently at the General Electric Research Laboratory.

Attended by 300 scientists, the meeting was jointly sponsored by the division of physical and inorganic chemists of the American Chemical Society and the division of solid state physics of the American Physical Society.

Twenty-seven scientists at the meeting reported on late developments in the growing investigation of impurities.

For example, impurities in the proper amounts, located properly, control the functioning of transistors, the tiny devices that can do the work of many vacuum tubes.

They govern actions of phosphors that make possible fluorescent lights and paints, as well as television tubes. They also govern the performance of photographic film.

Since the discovery five years ago that semiconductors sometimes can be used in place of vacuum tubes, scientists have been busy finding out the exact role of all-important impurities like antimony and aluminium in germanium and silicon transistors.

GERMANIUM INGOTS

Recently, Dr. Robert N. Hall, a young General Electric Company physicist reported on a way to make germanium ingots that include 100 layers of impurities from which thousands of transistors can be manufactured. Other methods can only produce one or two such layers.

Progress is being made in the study of impurities in phosphors. Scientists' efforts already have brought them knowledge about properties of luminescence that never were understood a scant five years ago.

Phosphors, scientists have found, are lighted in many ways. Ultraviolet radiation touches off fluorescent lamps. X-rays light up fluoroscopic screens used in medical diagnosis. High velocity electrons light up television screens. Impurities called activators are essential to the luminescence of these phosphors.

Each day studies of these minute impurities are revealing additional information. So far, about 43 such important impurities in phosphors have been catalogued. Manganese, for example, is one used widely as an activator.

Some phosphors, like semiconductors, work best at high temperatures, some at low. But a great deal of investigation still is needed to predict how certain combinations of phosphors and impurities will act at a practical range of temperatures.

Impurities, scientists have found, touch off rain and snow in supercooled clouds. They have found that natural impurities ranging from dust to salt from sea air set off precipitation. When nature fails, G-E scientists have found silver iodide and dry ice successfully seed favorable clouds.

EFFECT OF IMPURITIES

Impurities also play a vital part in determining the strength, stamina and ductility of metals and alloys, physicists have found in recent years. They learned that small defects in the crystalline structure of these materials substantially alter their ability to stand up under strenuous punishment.

Metallurgists are learning to mix new alloys and adapt hitherto little-known metals to meet the demands for lighter yet tougher materials for use in jet engines and high-speed turbine rotors.

Scientists in the G-E laboratory's metallurgy department in recent years found that impurities cause metals to solidify at temperatures below those where they melt. Traditionally, it was held that these metals melted and solidified at the same temperature reading. Studies at the G-E laboratory proved, too, that the slightest traces of impurities are enough to make metals solidify at temperatures above the point where pure metals "freeze".

Scientists at the symposium reported on the increased sensitivity to light produced by impurities in photographic films. Lead salt, for example, can heighten the sensitivity of emulsions used on x-ray films. Certain dyes improve the action of emulsions of many other films.

WORTHY OF RESEARCH

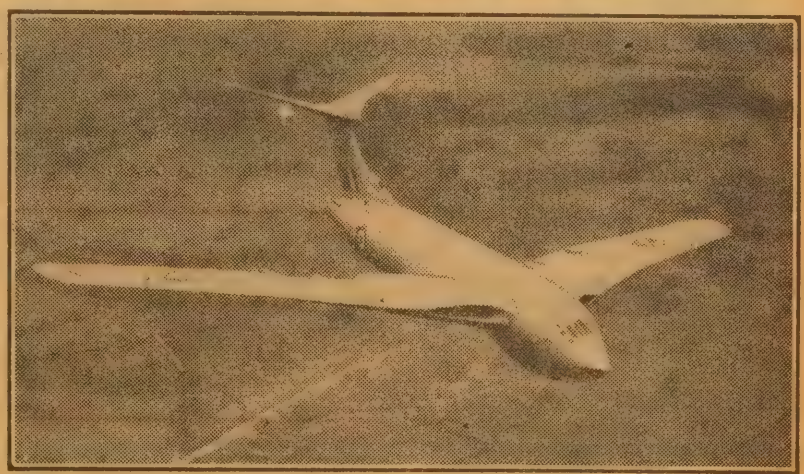
At the opening session, Dr. Frederick Seitz, of the University of Illinois, had this to say about the over-all importance of impurities:

"It is a notable fact that an exceedingly large number of the most interesting properties of crystals find their origin in imperfections."

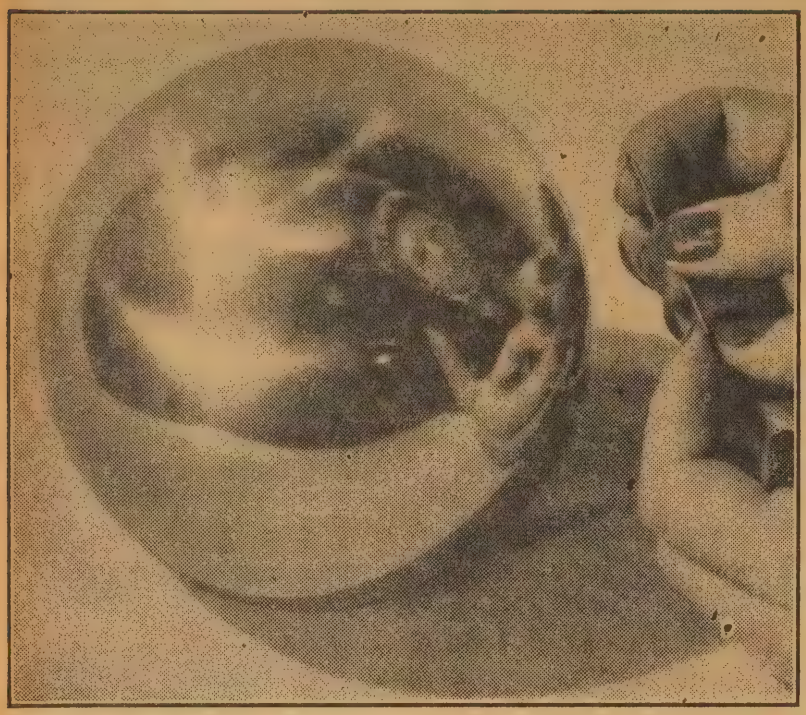
He said that "two or more imperfections of the same type, or of different types, may interact to generate other imperfections so that the group forms a closely interlocking family.

"This feature of the imperfections," he added, "is regarded as an essential part of their pattern of behavior intimately related to the normal properties of the imperfections. The interlocking characteristic of imperfections represents as important a property as their individual behavior."

FLIES AT THE SPEED OF SOUND



Here is the Handley Page "Victor" 4-jet crescent-wing bomber more powerful than 25 express locomotives. The Victor was ordered in quantity from the drawing board and is now in super-priority production for R.A.F. Bomber Command. Its revolutionary crescent wing enables it to cruise at high altitude with near-sonic speed. The Victor is the outstanding example of the modern concept of a bomber as a rapier—an automatically hard-hitting weapon able to paralyse an enemy's nerve-centres and yet, by outstanding performance, avoid normal fighter interception.



Two extremes in the range of steel balls—a precision ball six inches across and another which will pass through the eye of a needle. Balls for the wartime Norden bomb sight count 70,000 to the tablespoon.

HOW BALL BEARINGS ARE MADE

To reduce to a minimum the friction between the surfaces of two moving bodies has been the aim of engineers from time immemorial. It is probable that this aim was motivated not so much by the desire to prevent wear in the moving parts as to achieve a position where work could be done with the least expenditure of human energy.

by Calvin Walters

NOW this aim is one which is common to all humanity. We all want to make manual labor as easy as we can, and, if we can get out of it altogether, the better are we pleased.

Hence history has shown that from the earliest times man has attempted to minimise his labor with all kinds of gadgets, especially in fields devoted to the transport of materials and digging the soil.

In recent times there has been a great increase in the supply of labor-saving gadgets—so much so that we are now said to be living in the "gadget age".

SMALL ENGINES

One of the greatest advances of modern times has been in the development of the internal combustion engine. As well as in the field of transport, the small internal combustion engine has been the means of lightening the labors of the man about the house as instanced by the great increase in the use of motor-powered lawn-mowers.

The lawn-mower, to a great many people, is the most infernal machine ever invented, for it is doubtful whether lawns would be a practical proposition without one. Hence no sooner had it been invented than a new source of annoyance came into being—the lawn. Many a man has rued the day he planted a lawn, with its subsequent hours of hard labor at week-ends, while other people living in flats played golf, tennis or bowls.

Today, however, with the advent of the motor mower the lawn has no terrors, and work which previously took hours to get through with sweat and toil is now done in a matter of minutes while "one reads the paper".

With the development of these high-speed engines, efficient methods of reducing friction has become a matter of major importance.

The development of jet engines in planes has added to the complications of the matter.

Strange as it may seem, the most efficient system of friction reduction is one which has been with us for many years—the ball and roller-bearing—and it is the intention of this article to describe as simply as possible the principles involved and the method by which a ball-bearing is made to such extreme accuracy.

ROLLER "BEARINGS"

The principle of rolling friction was known in the very earliest times. This is proved by the fact that pictures on caves and old tombs depict such things as primitive vehicles with discs of wood as wheels.

Natives of those times used logs upon which to roll other logs to a certain destination.

The Bible mentions that the chariot wheels of the hosts of Pharaoh were removed when the Israelites were crossing the Red Sea.

There are many evidences of the use of rollers to reduce friction, and it is difficult to discern just at what point in history the ball-bearing came into being.

It is believed by many that the earliest example of such in the form of a thrust bearing was that used in the old Post Mill at Sprowster, Norwich, England. This was built in the year 1780, and the bearing is now in the Bridewell Museum, Norwich.

The first patent for a ball-bearing to take a radial load was taken out in 1794 by Phillip Vaughan in England. Since that time, many improvements have been made, and many patents have been taken out which have all contributed to make the ball-bearing the most efficient of all friction-reducing devices.

As stated previously a load can always be moved with less effort when it is mounted on rolling supports than when it is mounted on supports which slide.

The reason for this is clear when it is realised that no surface, not even when finished to the highest degree of modern mechanical perfection, is free from hills and hollows. Under the highest magnification a highly polished surface will appear like the surface of a piece of fine sandpaper.

Now when two such surfaces are opposed to each other some of the hills on one will locate themselves in the hollows of the other, and thus any attempt to slide the surfaces together will result in a resistance which will increase as the load on the surfaces increases.

There is an additional resistance caused by the adhesion of the two surfaces because of the existence between them of an extremely thin film.

A good example of this is the engineer's block gauge. The surfaces of these gauges are finished so perfectly that once brought together it is almost impossible to pull them apart except by sliding, and even this is very difficult. That this resistance is not due to atmospheric pressure alone is evidenced by the fact that the force required to pull them apart is much greater than can be accounted for by atmospheric pressure.

At about the end of the nineteenth century Professor Osborne Reynolds carried out some important investigations into the movements of rollers in contact with elastic materials. With later experimenters he found that when the roller was rolled across another surface the hills and hollows of each surface fitted into each other as mentioned above but, in the forward motion of the roller, these irregularities act somewhat in the manner of gear teeth and therefore do not offer the same resistance to motion as they do when both surfaces are flat.

Another effect takes place in that, at the point of contact of the rolling element with the other surface the latter is depressed and the roller is flattened. Admittedly this distortion is very small but it exists nevertheless, and has a small frictional effect.

The most common forms of rolling bearing are the ball bearing and the roller bearing. Many millions of steel balls are made per year which are used to make simple bearings for small machines and the most complicated systems for very large high-speed machines.

MASS PRODUCED

Both of these types are classified as rolling bearings and their manufacture is a matter of the highest precision. At the same time they must be made as cheaply as possible under mass production methods.

It was not until the beginning of the 20th century that the development of the bearing gained impetus. The lack of suitable metal which could withstand the stresses of the lightest loads retarded development prior to this.

Under load a bearing metal is subjected to varying stresses comprising tension, sliding, deformation, flexure and heating of the surfaces at the point of contact. At the point of contact of a ball bearing the stresses may be up to 200 tons per square inch.

In the early stages the metal used for bearings was a case hardened steel. This was satisfactory up to a point but certain properties of such metal removed it from the category of the ideal.

With the development of metallurgy a trend took place to the use of alloy steels correctly heat treated.

A satisfactory steel must have a very high standard and possess the following properties.

RAW MATERIAL

Great strength and hardness. Uniform hardness and structure. Fine grained texture. High resistance to fatigue and wear. Freedom from soft spots and segregations. Freedom from impurities. Minimum brittleness.

It is extremely important that this latter quality be maintained as one faulty ball in a bearing will cause the breakdown of the whole device and may cause thousands of pounds damage to a valuable machine.

The steel mostly used today is a chrome steel containing 1.5 pc of chromium.

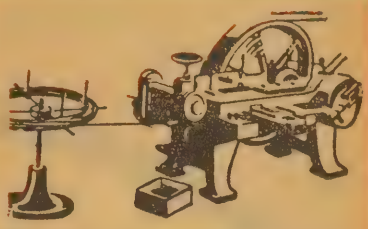
The steel is usually in the form of wire and constant tests are maintained throughout the manufacture. These consist of both microscopic and macroscopic tests and comparative tests with standard microphotographs. Test pieces are etched with special acids to test porosity and the presence of blow holes and pieces of impurities such as slag &c. The steel wire is tested for hardness. Pieces are broken off and hardened at the temperature required. They are then examined under a low power microscope to see what alteration has taken place to the structure.

This also determines if the steel is suitable enough to respond to the hardening process and also further detects flaws, slag impurities &c.

Having satisfactorily settled the question of the suitablity of the steel the coil of wire is placed in a machine which cuts the wire into blanks of a size suitable to the size of the bearing to be made.

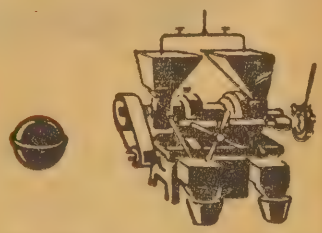
For bearings up to ¾ of an inch diameter the steel is in the form of wire but for larger bearings the steel is hot pressed into a rough shape from steel billets.

Whichever is used the subsequent process is the same for both. The blanks from the wire are passed between a pair of dies which are hemispherical in shape. These

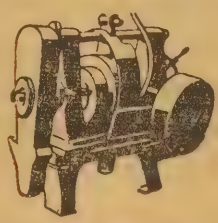


1—Balls start as section of drawn wire (sketches by courtesy of SKF)

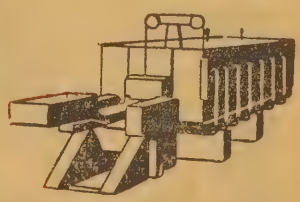
2—Shaping the wire rods into balls.



3—Filing discs remove the burr.

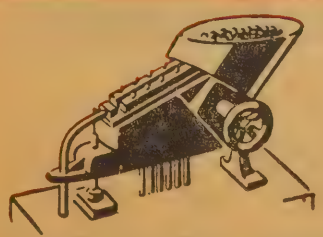


4—They are ground between discs with concentric grooves.



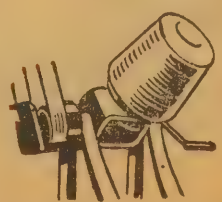
5—Hardening and tempering.

6—Further grinding with the axis of rotation always changing.



9—Grading to a tolerance .001mm.

8—The final visual inspection



7—Polishing in rotating drums

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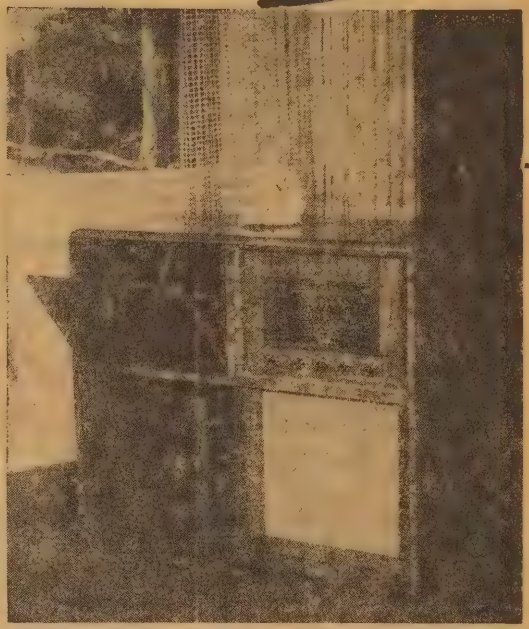

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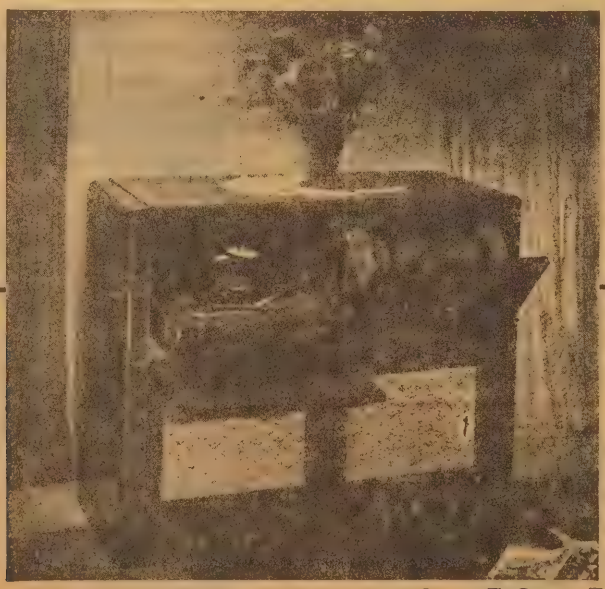

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squeeze the blanks into a rough sphere. The surplus metal which squeezes through at the junction of the two dies forms a "fin". This fin is ground off the ball which at this stage is only an approximation of the true spherical state.

The balls now pass between discs of grinding material which are rotating at different speeds and the axes of which do not coincide. The balls are guided between the discs by means of stationary guide plates. The result is that the balls are forced to change their axes of rotation so that the entire surface is repeatedly ground between the discs.

The balls are now placed in a rotating barrel filled with an abrasive compound. Here the balls are ground to size and proper condition ready for heat treatment.

Hardening is accomplished by heating in a closed furnace to 820 degrees Centigrade, and quenching in a light spindle oil. This process is followed by tempering. This necessitates the parts being heated to 150 degrees Centigrade for an hour. These thermal treatments are rigidly controlled throughout the operations.

PRECISION GRINDING

After hardening and tempering comes the precision grinding process. The balls pass between a stationary cast-iron disc and a revolving grinding wheel. Both these are provided with a series of concentric grooves and the iron disc is gradually brought toward the grinding wheel.

Thus a pressure is created which forces the balls against the wheel and this pressure is accurately registered on dial gauges. As the ball, held in its groove, reaches the bottom of the wheel it falls out on to pick up fingers, which conveys it into another groove, and so on until the ball has traversed all grooves, and has been ground on the wheel on different axes. This operation lasts for some hours and is continued on several similar machines until the balls are as uniform as it is possible to make them by mechanical means.

At this point the balls have a fine matt finish. They are then placed in rotating tumblers, which contain fine abrasive and oil. After several hours in these tumblers the balls have a much better finish.

They are then tumbled in barrels of sawdust and finally in tumblers containing strips of soft kid leather. This produces the final high polish.

As it is impossible to make balls all exactly the same size they are graded. This is done in automatic grading machines, which are provided with a pair of knife edges set slightly out of parallel and on a slight incline. As the balls roll down the knife edges they drop through at the points coinciding with their diameter into receptacles.

Previous to the grading the balls are subjected to inspection under diffused light for the purpose of detecting flaws or grinding marks. This is a highly specialised process and is done by trained experts.

The grading machines are so accurate that in any dimensional group the difference in size does not exceed four one-hundred-thousandths of an inch for smaller sizes or eight one-hundred-thousandths for larger sizes.

The cages in which the ball-bearings are mounted for use consist of an outer and inner ring. These rings are in themselves a high grade precision production. The quality of steel must be equal to that of the balls themselves and they are subjected during manufacture, to over 60 separate inspections and checking operations. The gauges used throughout consist of a set of master block gauges and are kept for reference.

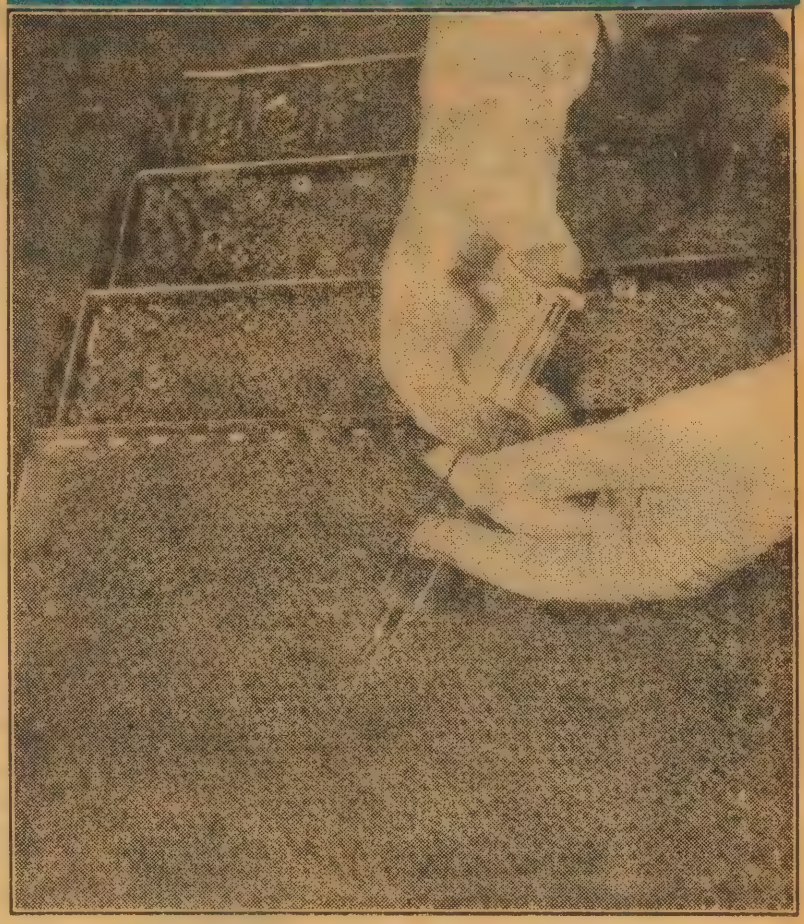
All these gauges are used at a standard temperature of 20 degrees Centigrade. There are other sets of gauges, which are used in conjunction with a sensitive comparison meter. The instrument magnifies discrepancies some 3000 times on a graduated scale so that high precision in measurement is maintained.

It will thus be seen that the manufacture of ball-bearings is a matter of high precision and maintenance of quality. The fact that this type of bearing has stood the test of time speaks highly for its great usefulness.

At the time of writing the great Round Australia car reliability test had just begun. The result of this test rests almost entirely on the quality of the bearings used in the moving parts of the motors and transmissions.

A moment's thought will result in the conclusion that civilisation itself rests on the quality of machines which in turn rely for their efficiency on the stability of the bearings in the moving parts.

OIL FOR MINIATURE BEARINGS



A hypodermic needle to insure precise oiling. This is essential for miniature bearings, which often revolve at speeds beyond 100,000 revs. per min.

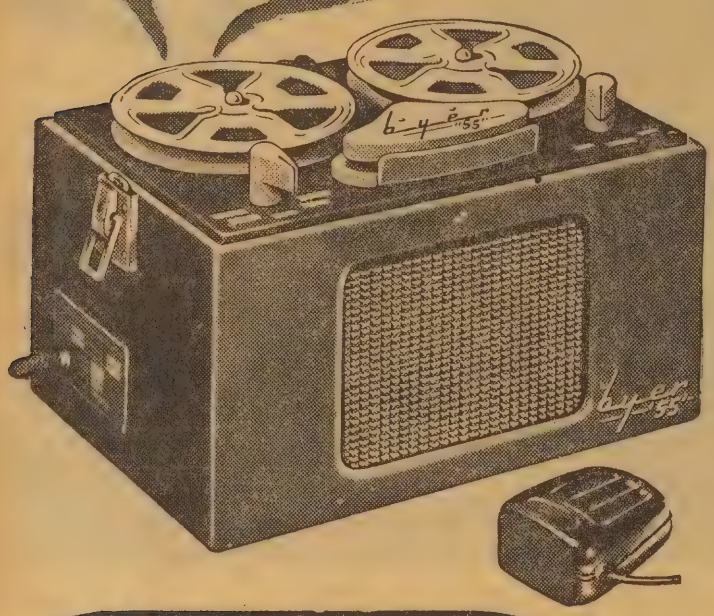
Combined developing and fixing baths

FILM and paper prints of aerial photographs can be successfully developed and fixed all in the one bath, H. S. Keelan of Boston University's Physical Research Laboratories told the Society of Photographic Engineers meeting at West Point N.Y.

Four mono-baths, as they are called, were evolved to reduce the time, space, and equipment needed to process aerial pictures. These mono-baths contain various amounts of commonly used photographic chemicals.

A proper balance between developing and fixing is obtained by varying emulsions contrast, acidity, temperature and agitation. A loss of photographic speed of from 40pc to 50pc in the mono-baths is compensated for by the use of opaque dyestuffs placed on the silver particle of the photographic image during development.

The ONLY truly portable miniaturised tape recorder with "SOUND QUALITY"



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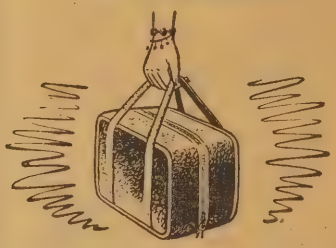

The BYER '55' is TRULY PORTABLE because of its light weight and small size — only 12in x 7¾in x 8in high. A completely self-contained unit.

Controls are simple—single knob selects record . . . replay . . . fast forward . . . rewind . . . stop. Separate control adjusts correct level for recording indicator, selects desired volume for replay and incorporates mains ON/OFF switch.

byer "55"

MAGNETIC TAPE RECORDER

The BYER "55" is designed and manufactured to the same high standards that typify all BYER radio and audio equipment. This amazing miniaturised tape recorder features the famous BYER "sound quality" in an acoustically-correct styled-right cabinet (plus a smart tan carry cover)—and throughout assembly all bearing and friction surfaces are lubricant packed . . . no user-maintenance!

Would you please send me full particulars of the Byer "55" Magnetic Tape Recorder.

Name: .....

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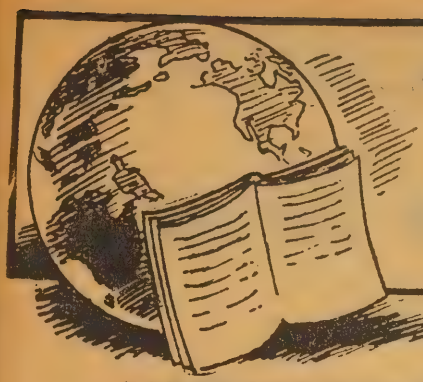

Technical Review

RADAR-CONTROLLED A.A. GUN OPERATES AUTOMATICALLY

Time lost in aligning anti-aircraft gun batteries with early radar types introduced errors. This fact, plus advances in blind bombing techniques and increased aircraft speeds, presented a new challenge for defence weapons designers.

ONE answer is the Skysweeper, recently shown to the public by Sperry Gyroscope for the first time.

The weapon is a self-contained (except for power plant) radar-controlled 75-mm anti-aircraft gun that can be placed in operation in less than five minutes. The radar system, sharing a common mount with the gun, is permanently fixed with respect to the gun barrel and is so arranged as to provide automatic tracking of a target.

A built-in computer system determines firing azimuth and quadrant elevation on the basis of present position, aircraft speed and direction, muzzle velocity, air density and trunnion tilt, as indicated in Fig. 1.

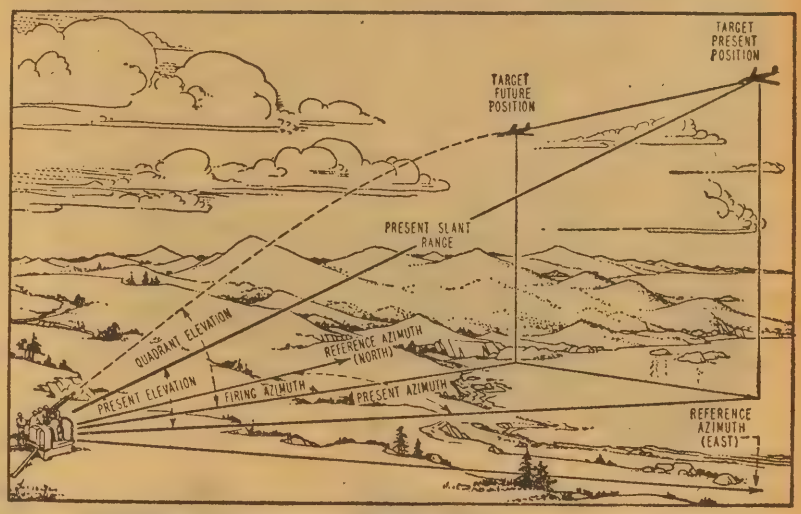

Figure 1: Pictorial representation of fire control problem.

SEARCHES WHOLE SKY

In operation, the unit is placed in ppi scan and the entire sky is swept in 40 seconds over a 15-mile radius. When a target is picked up on the ppi cathode-ray tube, the system is switched to automatic tracking and the computing elements go to work extrapolating the aircraft's future position and automatically making necessary corrections for firing shells on a collision course with the target.

The gun is provided with an automatic loader-rammer, loads and fires 45 proximity-fused shells a minute.

The radar system uses a two-foot parabolic reflector with a waveguide-fed antenna that is mechanically switched to send out two overlapping beams.

When the antenna system is pointed so that equal signals are received from reflections of each beam the target is on the beam. When unequal signals are received, error or difference signals set servo-mechanisms in motion that correct the deviation.

The radar console houses all subassemblies except the antenna assembly, which is mounted on a hinged yoke on top of the console so it may be lowered in transport. The radar is divided functionally into a synchronising system, transmitter, antenna, receiving system (the RF portion being separate), the servo, indicating data transmission and control systems.

When a target is sighted on the search radar CRT and the operator switches to radar tracking this action sends present azimuth, present elevation and slant range information to the computer.

Using this information, computer servos actuate computing elements that automatically calculate gun aiming data.

Twenty-two electronic chassis control the movement of the mechanical computing elements.

Aided manual ranging, used to track the target in range when automatic range tracking is impossible, involves keeping the target at the tracking point by rotation of the range handwheel. Under this condition, all other automatic functions are maintained. Other alternative ranging methods include estimated altitude and stored altitude operation.

GUN-LAYING DATA

The computer transforms data representing the present position of the target into data for aiming the gun, with correct lead. Under normal tracking conditions, the present-position data consists of the target azimuth with respect to the chosen reference line, target elevation with respect to the horizontal plane of the gun mount and slant range.

These qualities, shown diagrammatically in Fig. 1, are utilised by the computer in the solution of the fire control problem. The computer output consists of quadrant elevation and firing azimuth of the gun tube.

The computing action takes place almost instantaneously. The point of intersection of the target and the projectile paths and the correct gun positioning data are continuously computed. The power control unit keeps the gun positioned.—"Electronics," May, 1953.)

A TEST OF BINAURAL broadcasting on AM was made recently by Rensselaer Polytechnic Institute, Troy, NY, in co-operation with WGY, WTRY, WHAZ, WPTR, and WXKW. Two microphones spaced about 10 feet apart were linked by wire lines to separate transmitters. A third mike, midway between the first two, fed both lines simultaneously. Listeners were advised to use two receivers tuned to equal volume, with the same 10-foot spacing between them.

Most binaural broadcasting done in recent months has been by simultaneous transmission over AM and FM stations. The Rensselaer experiment is the first one reported in several years using AM transmission only.

Reports from the public agreed with a special panel of six experts that this form of binaural transmission was highly effective on small vocal groups and solo instruments, but not so good for band music because of confusing reverberations.

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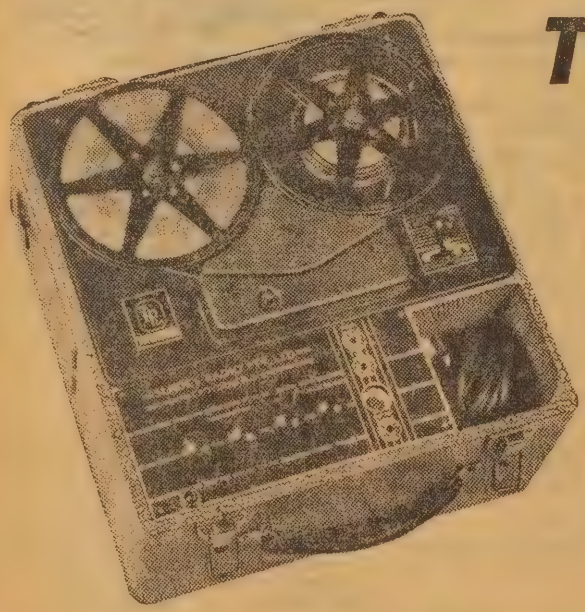

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NO OBVIOUS SOLUTION TO TELEVISION 3D PROBLEM

The July, 1953, issue of "Wireless World" carries an article on "Stereoscopic Television", which reviews current thought on the subject in Britain. It indicates that no sensational solution is yet available to the problems of 3D for TV.

THE writer points out that speculation about 3D for the cinema leads logically into the question of 3D for television, for the optical problems are essentially the same for both.

While the BBC is watching developments with interest, it is not likely to sponsor any of the systems so far suggested, if only because none of them is compatible with the present services.

Apart from the optical problems involved, there is the further problem of available bandwidth. A picture which contains separate right and left-eye information must either have twice as many picture elements for the same resolution or must suffer reduced resolution in the effort not to involve extra bandwidth.

There is some evidence that the third dimension will compensate in part for a loss of picture detail, but not sufficiently to overcome the basic problem. This further supports the idea that 3D might be applicable to a new service, but not to an existing service where compatibility is important.

USUAL PROBLEMS

In the matter of presentation, the same problems are involved as in the cinema. Thus, simultaneous images can be viewed through spectacle-type filters, with their familiar inconvenience and loss of light.

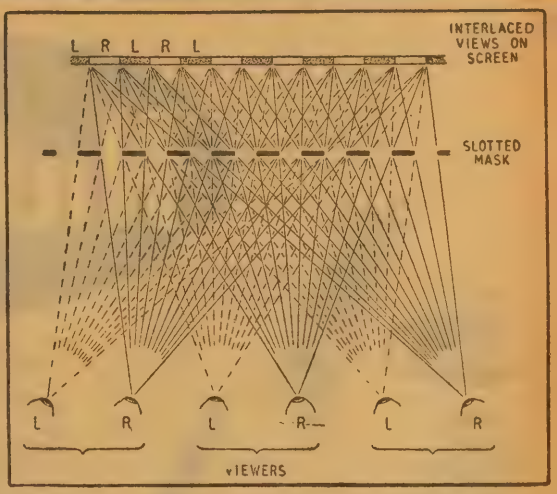
Right and left images can also be presented in rapid time sequence, but, once again, the viewers must wear some kind of optical device.

The scanning system which is inherent in the presentation of a television image, can itself be utilised to separate the stereo images, as for example, by using the odd lines for the right eye and the even lines for the left eye.

However, any system based on this idea presents individual eyes with a 25-frame picture and may lead to flicker.

3D systems which do not require glasses are, for the most part, a variation of the system suggested by Ives in 1902.

The left-eye view and the right-eye view are presented together on the screen by being split into small vertical sections and interlaced—as shown by the alternating "L" and "R" sections across the screen. A short distance in front is the slotted mask, and this is arranged so that, when the spectator looks through it, his left eye only sees the "L" sections and his right eye the "R" sections.



Stereoscopic viewing device. The viewers' left eyes can only see the sections of the left-eye view (marked L) on the screen and their right eyes only the sections of the right-eye view (marked R).

Each eye then integrates the thousands of small sections it sees into a complete picture.

The process of getting the two views interlaced on the screen in the first place is simply the reverse of the viewing process—that is, to project them from different angles on to the back of the screen through a slotted mask.

How then, could this principle be applied to television? At the transmitting end the left-eye view and the right-eye view are interlaced on a translucent screen by means of a slotted mask. The composite picture is then viewed by a camera and transmitted to the screen of the receiver, where the two views are separated by another slotted mask.

This could be done with an existing television system and no changes would have to be made. The system would not be "compatible", however, because the picture without the mask would be blurred.

The system has two inherent disadvantages. The first is that a spectator looking obliquely at the screen from the side sees the same three-dimensional image as he would do from a central position, when clearly he should from that position get more of a side view.

The second drawback is that between the viewing zones, where the correct stereoscopic effect is obtained, there are zones in which the spectator gets an "inverted" stereoscopic effect, the right eye receiving the left-eye view and the left eye the right-eye view.

These "inverted" zones are the same width as the others, so that when the spectator moves about he sees the picture "jumping in and out".

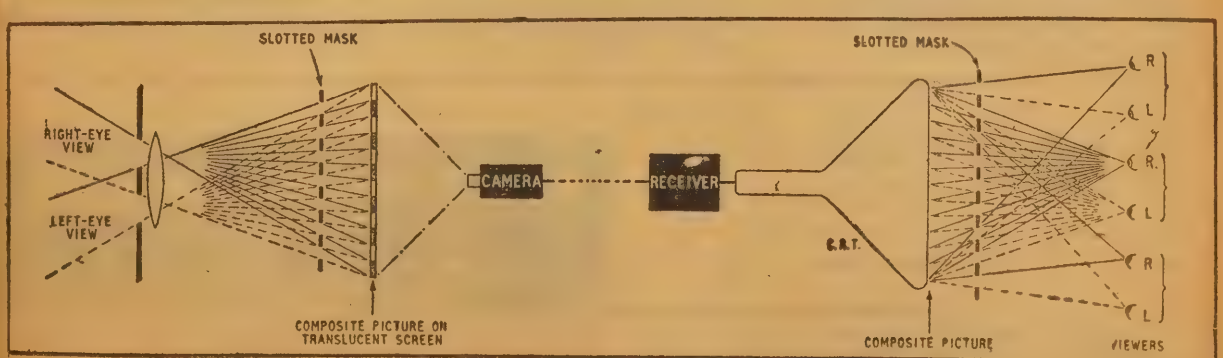
A system has been devised, however, which partly overcomes these disadvantages, and readers may have seen something like it used in shop windows for advertising purposes—a three-dimensional photograph which changes appropriately in aspect as one moves around it.

PICTURE STRIPS

The photograph is produced by moving a camera, with an adjustable slotted mask in front of the film, around the subject in an arc. The result is a picture composed of a series of vertical strips in each of which the viewpoint changes gradually from left to right. The composite picture does not contain just two views, but a number of views from various angles merging into one another. When this composite picture is viewed through a slotted mask, each position gives a slightly different view from the next.

As the spectator moves to the right the view of the film becomes increasingly right-sided and vice-versa, and all the time a difference

(Continued on Page 111)



Possible stereoscopic television system utilizing the principle illustrated above.

Where quality is essential specify . .

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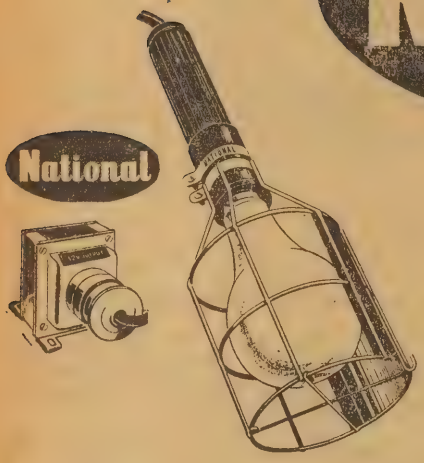

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Ideal for roof and under floor jobs, as a bench light and a safe convenient light for engine and under chassis repairs.

Introducing

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. . . a new, APPROVED lead light . . . does NOT operate on a lethal voltage . . . directs light where needed. FEATURES: ● Complete and ready for immediate use ● Operates on safe 32 volts from National step-down Transformer connected to mains supply. ● 24ft of cable connects Transformer to lead light. ● Gives concentrated light where needed. ● Lamp reflector shields operator from direct glare. For Safety's sake always use National Safety-Lite. Remember — the LIFE you protect may be your own!

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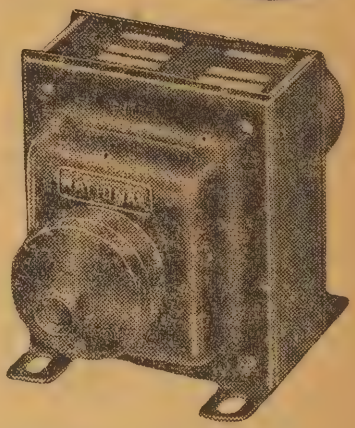

STEP-DOWN TRANSFORMERS

Made by National's specialised factory, available in a wide range.

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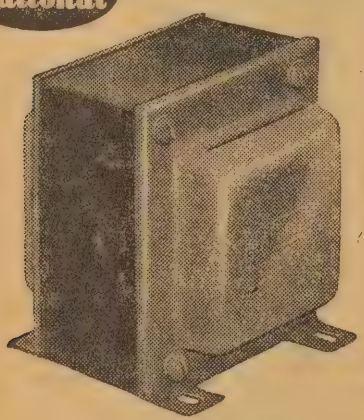

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Available in a wide range of upright and flat types. They are particularly quiet . . . cool . . . tough. Used exclusively by many of the largest radio manufacturers.

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. . . feature 3-way bakelite input plug and outlet socket for easy installation and robust mounting brackets for wall or bench mounting.

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INTERCOM NEWS:

National Power Transformer U30/150 and National Filter Choke A12/50 were selected for the "Two unit Intercom." featured on page 28, September, Radio & Hobbies.

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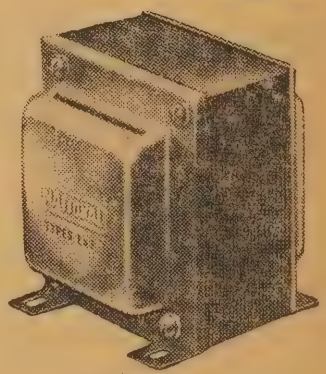

FILTER CHOKES

Coils are impregnated with special varnish and baked to resist humidity.

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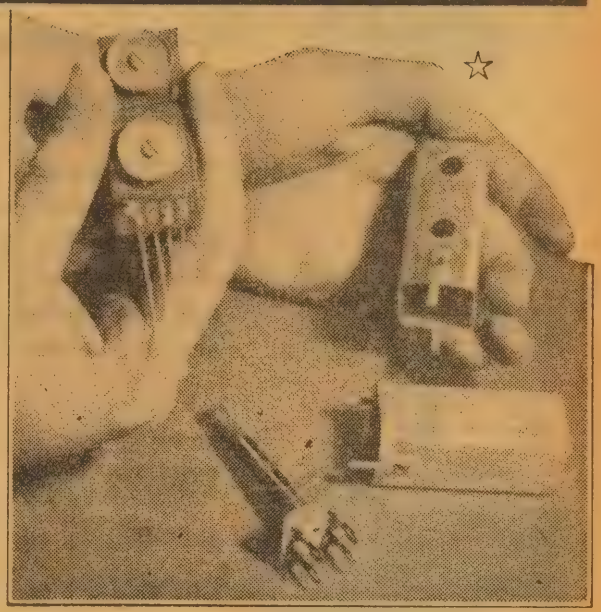
A NATIONAL PRODUCT FOR A NATION'S NEEDS

RCA COILS, I-F TRANSFORMERS ARE NOW BEING PRINTED

Radio, TV receivers, and communications equipment that can be made more compact and efficient were envisaged with the announcement that printed circuit electronic inductors, mass-produced for general use by the Tube Department of the RCA Victor Division, are now generally available. In such components, printed circuitry replaces conventional wire windings with coils that are etched on flat surfaces.

THESE revolutionary components, at present limited to six types of intermediate frequency (IF) transformers, induction coils, and wave traps, are produced by a special process which makes possible virtually limitless production of identical electronic circuits from a single photographic negative.



A complete printed circuit, IF transformer and its shield (in hands) are compared with older type components (on table) to show comparative sizes.

COIL ELIMINATED

Conventional inductors depend upon coils of hand-wound or machine-wound copper wire to provide the desired inductance values. With the printed circuit method, the coils of copper wire are eliminated. Instead, inductances are provided by flat inductors having rectangular windings which are photographically printed on plastic strips on which a layer of copper has been deposited.

The production of a printed-circuit component begins with a photograph of the pattern of the required circuit. A contact print of the negative is then made on a copper-clad plastic strip which has been coated with a light-sensitive material.

Following this operation, the strip is developed and placed in an etching solution. The unexposed parts of the copper are eaten away, leaving an accurate, sharply defined reproduction of the desired copper circuit. After the strip has undergone additional processing, it is inserted in a metal case or shield.

So precise that it will faithfully reproduce a line width of copper as narrow as one-hundredth of an inch, the process assures the uniformity of any quantity of "copy" circuits produced by the master circuit on the photographic plate.

The photographic printing of electronic circuits presages unprecedented accuracy in the production and assembly of components and provides precision control of such vital factors as the coefficient of coupling.

CHEAPER PRODUCTION

Further, the printed-circuit technique points the way to more economical and streamlined production of components, makes possible circuit arrangements impossible under conventional wire-winding techniques, indicates appreciable simplification in component design, and facilitates rapid and inexpensive circuit changes since only a new negative is required.

Printed-circuit components themselves, by nature of their radical design and high uniformity, make possible simplification of equipment design, reduction in the number of required parts, and a simplification of equipment servicing and alignment.

Simplification of servicing and alignment are illustrated by the new RCA components, which are housed within tiny metal shield cans measuring only seven-eighths of an inch square and 2¼in high.

The new components are intermediate-frequency types designed for television sets utilising intercarrier-sound systems and incorporating picture IF and sound IF carriers of 45.75 and 41.25 Mc, respectively. —(Radio Age, July, 1953).

EGGSHELL RAISES HF RESPONSE

RUDI PFENNINGER, noted German authority on synthetic music and high-frequency speakers, recently demonstrated an ingenious trick for improving the h.f response of a cone type speaker.

The pointed half of an egg-shell, cemented in the centre of the speaker cone, gives a remarkable improvement in h.f. response.

Cutting the shell requires care and patience. Place a hard-boiled egg, pointed end up, in an egg cup, and very carefully scribe a line around the outside edge (slightly below the greatest diameter) with a fine-bladed knife.

Then slowly and delicately file through the shell along the line with the edge of a triangular needle file, holding the egg only at the tip.

When the shell has been filed through all around, slice through the egg with a razor blade. Remove the yolk and white from the top half (don't crack the shell while doing this!) and let the shell dry completely. Then smooth the filed edge with a fine sandpaper.

Fasten the shell to the apex of the speaker cone with Duco or speaker cement.

The shell was tested on a hand-made 10in speaker which had excellent bass response but was very poor on the highs. The improvement was remarkable. As was expected, the newly heard high frequencies were strongest along the axis of the cone.

The eggshell will naturally replace the paper or felt dust-cap which is fitted to most modern speakers. While affording adequate protection, if carefully fitted, the shell has vastly better properties as a radiator of high frequency energy.

High Voltage Removes Dirt From Grain

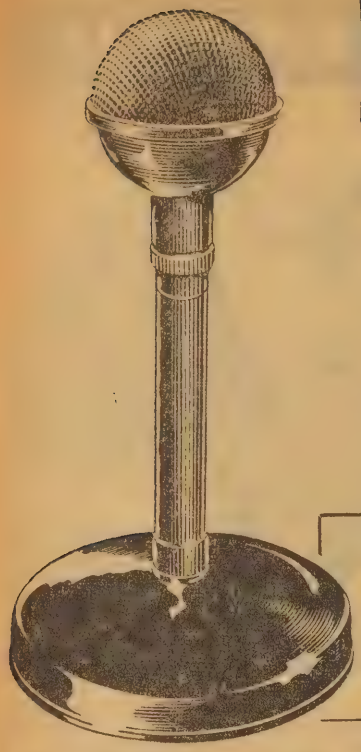
Electrostatic separation cleans grain to a degree considered impossible before its use. Now at work in five corn mills, it has reduced impurities to an almost undetectable level.

The electrostatic separator is placed at the end of the normal dry cleaning line. The grain passes over six grounded conveying rolls and past electrodes charged with 30,000 volts. The foreign matter takes a greater charge than the corn and is deflected out of the falling stream into a reject hopper.

Most of the foreign matter is removed at the first two rolls. The last four rolls finish the cleaning process. Reject from the roughing rolls is run through a mechanical cleaning system, and then over two reclaiming rolls.

The company is now experimenting with cleaning of other grains.

"ACOS" CRYSTAL MICROPHONES



MICROPHONE TYPE MIC 22

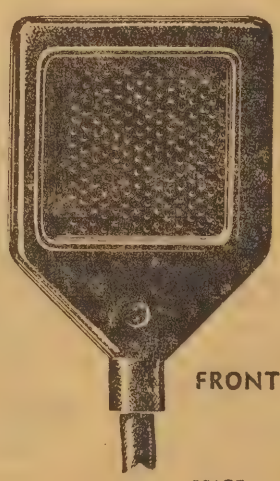
Mic 22 is available in 2 types.
Mic 22/2 being complete with desk stand as illustrated.
Mic 22/1 consists of the microphone with nickel plated stem at the end of which is fitted a screwed adaptor which will fit British or American type standard floor stands.
Mic 22/1 can also be used as an effective hand microphone.

MIC 22
PRICE
£9/18/6

SPECIFICATION

Output impedance . . . Equivalent to approximately .002 MFD. (.8 megohm at 100 cycles)
Omni-directional.
Frequency response . . . Substantially flat from 40 to 6,000 cps.
Recommended load resistance . Not less than 5 megohms
Output level . . Minus 50 db below 1 bolt/bar.

MIC 28 LAPEL MICROPHONE



PRICE
£5/19/6

Impedance 100,000 ohms at 1,000 cps.
Capacity .0015 mfd at 24 deg. C.
Output level approximately .55db. Ref. 1 volt/dyne/cm2.
Recommended load resistance not less than 5 megohms.
This small non-directional microphone has been designed to allow freedom of movement for public speakers or broadcasters. The dimensions of the MIC 28 are 1 9-16in. wide by 2¼in long by 5-8in thick. It is housed in a soft moulded rubber case which gives added protection against shock. The microphone hooks on to the lapel of a suit or coat. A 6' cable is supplied The MIC 28 has a level frequency response throughout the whole of the audible frequency spectrum, and consequently gives excellent fidelity of reproduction.

(Sole Australian Representative)

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MIKE INSERTS

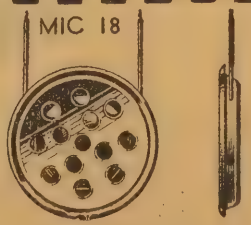
MIC 3

MIC 3. Diaphragm - actuated Crystal Microphone specially designed for the reproduction of speech frequencies With rising response from 1000 c/s, this microphone has exceptional sensitivity. Overall dimensions 1¾in. Price 39/3.-

MIC 14

MIC 14. Standard Speech Microphone itself, with nickel plate brass case, which gives high corrosion resistance mechanical strength and rigidity. Overall dimensions 1-7/16in. Price 39/3.

MIC 18



MIC 18. Microphone Speech insert provides high acoustic qualities with minimum bulk. Where exceptional slimness is required, this insert is recommended. Overall dimensions 1-7/16in. Price 39/6.

MIC 32. Sintercel fulfils the requirements for a flat insert with good sensitivity and a frequency response 30-7000 c/s. Unaffected by vibration, exceptionally robust construction. Overall dimensions 1-7/10in. Price £2/15/6.

NEWS AND VIEWS OF THE MONTH

A-bombs and weather

DR. VINCENT J. SCHAEFER, the original cloud-seeder and rain-maker, says that he doubts very much whether the debris from an A-bomb explosion had anything to do with a recent series of tornadoes in the US.

"From what I know about these explosions," he says. "I doubt if they could produce material which would make very good rain-making material. Silver iodide is the best, and I doubt if there were a lot of things as good as silver iodide."

Dr. Schaefer points out that the explosions kicked up some dust which is one of nature's instruments for making rain storms.

"But," he says, "the dust in an ordinary dust storm is so very much greater in amount than the little bit kicked up by an A-bomb explosion that I cannot see how the bomb's dust could have any effect on general weather conditions."

Weather bureau experts point out that a tornado is only a relatively small by-product in terms of energy, of general stormy conditions. These conditions release energy equal to many hundreds of thousands of A-bombs, and are the product of even greater forces at work in our atmosphere over the entire hemisphere.

A tornado itself, destructive as it can be, is a relatively puny thing, even beside an A-bomb. Averaging about 100 yards wide, about a mile high and travelling about 15 miles, it has energy only 2 to 3 pc of that of an A-bomb.

One thunderstorm is much more powerful, equal to about 50 A-bombs. Thunderstorms and hailstorms are also products of such general stormy conditions as produced the recent tornadoes.

Finally, the meteorologists say, similar A-bomb tests at a similar time last year were accompanied by only an average number of tornadoes.

Having heard so much about rain-making and the claims of being able to change the weather with a few pounds of silver iodide sprayed into the air, people very naturally believe that an A-bomb explosion might be connected with a tornado. Yet it would seem that an A-bomb does not produce the kinds of material which, according to the rain-makers, could influence the weather, and that the forces responsible for the tornadoes are, in fact, many times more powerful than man's puny efforts with the atom.

Kills cancer

A NEW clue to the chemical control of cancer is a fatty substance isolated from the small intestines of mice and rats. It destroys certain cancer cells in test tube studies.

Dr. Leslie R. Bennett, assistant professor of radiology at the University of California at Los Angeles School of Medicine, reports that the precise chemical nature of the material has not yet been determined.

The substance exhibited no effect upon most normal tissues in test tube studies. It does, however, possess slight damaging properties to blood-forming cells.

The relatively low incidence of primary cancer in the small intestine suggested that its tissues might contain substances which prevent changes ultimately resulting in cancer. The fatty substance isolated in the study might be one of the cancer-prevention factors naturally occurring in these organs.

The material has not been used in the treatment of established cancer in experimental animals.

Spark gap guards plane

MANY commercial airliners now are equipped with a gadget that protects the plane should it be hit by lightning while in flight. Usually metal planes are reasonably safe even if struck. Sometimes, however, lightning can damage radio equipment and start fires.

The protective device consists of a condenser, a spark-gap cartridge and several steel strips. The condenser is wired into the radio antenna lead-in near the point where the lead-in comes into the aeroplane. To lightning, the condenser presents an open circuit, but it does not stop radio signals from coming into the plane.

The spark-gap cartridge is connected to the antenna and to the plane's fuselage. When lightning strikes the antenna, the condenser stops it from running into the plane.

POPULAR SCIENCE QUIZ

Q. What are silicone plastics?

A. There are at present four main types of silicone production. These are coating and varnish resins, moulding and laminating resins, silicone rubber and fluids. The last two types make up most of the production volume.

The valuable properties of this plastic are obtained with silica in combination with one or more hydrocarbons. It will last at least 10 times as long as a comparable organic material. The excellent characteristics of this plastic are paving the way for its use in many applications in industry while in some cases, it has turned out to be the most satisfactory material yet found for the job.

Its many features include chemical inertness, useful surface characteristics, resistance to oxidation allowing long exposure to moisture, sunlight and general weather elements, non-adhesive qualities, resistance to heat, cold and moisture, excellent dielectric properties which, over a wide range of humidity and temperature, are better than conventional insulation.

Silicone rubber stays flexible at 110 degrees Fahrenheit and will withstand temperatures up to 350 degrees in continuous service and intermittent temperatures up to 500 degrees.

Q. Do all bees have the same color eyes?

A. Honey bees ordinarily have black eyes but according to Professor H. H. Laidlaw, of the University of California, young bees have been found having eyes of various colors. So far, eye colors observed are dark brown, chamois, buff, cinnamon, two shades of red, chartreuse, blue and intermediate shades.

It appears that eye color has to do with changes that occur in the genes of the insects. A selected eye color can be used as a marker which may be followed from one generation to another. Investigation into the "color" gene is being made in an effort to find out how other characteristics are inherited.

The intention is to develop bees capable of higher production of honey, and improved pollination of crops. Additionally, attempts will be made to build up resistance to disease, longer life, good comb building and non-swarming tendencies.

Q. What is the oldest fertile plant seed found to date?

A. According to reports, W. F. Libby, of the University of Chicago, has shown that ancient Manchurian lotus seeds still capable of sprouting are more than 1000 years old. Scientifically speaking, these are the oldest fertile seeds. Prior to this, the record was believed to be 237 years. Other claims have been made but have not been substantiated when checked under strict scientific supervision.

The method used by Libby of age determination of ancient remains consists of measuring the minute amounts of naturally occurring radioactive Carbon 14 contained in the specimen. Knowing the amount of remaining radioactivity, the age of the specimen can be determined with the aid of an atomic calendar developed by Libby. Comparisons have shown that this method gives results which agree with those obtained by other means in well established cases.

Applying the method to other ancient specimens gives an age of almost 4000 years to the well-known monument of Stonehenge in England and about 10,000 years to the Folsom Man presumed to be the first inhabitant of North America.

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AUDIO OUTPUT TRANSFORMERS

* Response Includes Correction due to Negative Feedback ** For Use With Rola 12-OX Speaker

TYPE AND MOUNTING	IMPEDANCE—OHMS		FREQ. RESPONSE		RATING WATTS	TYPICAL APPLICATION	PRICE
	PRIMARY	SECONDARY	DB+—	CPS			
893-23	5000, 7000	2, 3.7, 8, 12.5	1	*40-15,000	5	SINGLE 6V6G, 6AQ5 ETC, TO VC	28/3
894-23	500	2, 3.7, 8, 12.5	2	50-10,000	5	LINE TO VOICE COIL	26/3
900-22	2500, 5000	2, 3.7, 8, 12.5, 15	1	*40-15,000	15	SINGLE 807, EL34 ETC, TO VC	57/6
896-9	8000, 10,000	2, 3.7, 8, 12.5, 15	1	30-15,000	15	PP 6V6G's A OR ABI TO VC	62/6
897-9	8000, 10,000	100, 125, 166, 250, 500	1	30-15,000	15	PP 6V6G's A OR ABI TO LINE	62/6
763-9	3000, 5000	2, 3.7, 8, 12.5, 15	1	40-20,000	15	PP 2A3's A OR ABI TO VC	62/6
809-26	500	2, 3.7, 8, 12.5, 15	1	50-20,000	15	LINE TO VOICE COIL	42/6
870-26	10,000	2 or 8	1	*20-20,000	6**	PP 6V6G's OR 807's AS TRIODES	57/6
871-9	10,000	2 or 8	1	*20-20,000	12	PP 6V6G's OR 807's AS TRIODES	81/-
872-9	10,000	3.7 or 15	1	*20-20,000	12	PP 6V6G's OR 807's AS TRIODES	81/-
891-22	6600	83, 100, 125, 166, 250, 500	1	50-12,000	35	PP 807's ABI TO LINE	82/6
892-22	3200	50, 62, 83, 125, 250, 500	1	50-12,000	55	PP 807's AB2 TO LINE	97/-

DRIVER TRANSFORMERS

545-9	SE 4000 TO PP AB2 GRIDS 1.6:1. PRIM. TO ½ SEC RATIO 50-10,000 CPS 5 WATTS	57/6
588-6	SE OR PP 5000 TO PP 807's CLASS B. 200-5000 CPS 5 WATTS	52/6

MODULATION TRANSFORMERS

Primary: 3,800, 5,000, 6,600; 8,500, 10,000 ohms. Secondary: 4,000, 5,000, 6,000, 8,000; 10,000 ohms
150 mA. D.C. per side on Primary. 150 mA D.C. Maximum Secondary Current Ceramic insulators.
Freq. Response: 200-7,000 c.p.s. 75 Watts Rating £9/10/-.

POWER AND FILAMENT TRANSFORMERS

PT'S INCLUDE ELECTRO-STATIC SHIELD—ALL TYPES 50 CPS OPERATION

TYPE No.	PRIMARY VOLS	H.T.V. ASIDE	H.T. mA	FILAMENTS	PRICE
1682-H	220-230-240	285	60	6.3v-2A; 5v-2A	34/-
1636-3H	200-220-230-240	300	80	2 x 6.3v-2A; 5v-3A	42/9
1332-3H	200-220-230-240	300	120	2 x 6.3v-2A; 5v-3A	53/3
1356-3H	200-220-230-240	400	150	5v-3A; 2.5v-5A; 6.3v-4A	70/-
1380-3H	200-220-230-240	450	200	2 x 6.3v-2A; 5v-3A	95/-
1371-8	200-220-230-240	500-600-750 850-1000	300		150/-
1400-19	200-220-230-240	565-500-425	250	2 x 6.3v-3A; 2 x 2.5v-3A; 5v-3A	110/-
1643-23	200 or 230	—	—	6.3v TAP 5v-2A (500v insul)	17/6
1525-21	220-230-240	—	—	2.5v-10A (1000v insul)	47/6
1305-22	200-220-230-240	—	—	2.5v-10A (3000v insul)	75/-

FILTER CHOKES

Swinging Chokes Marked *

TYPE No.	INDUCTANCE-HYS		CURRENT mA	APPROX. D.C. RES.	MAX D.C. Working Vol.	PRICE
	MAX	FULL RATE DC				
957-23	20	15	60	320	500	16/6
973-9	30	20	80	370	500	33/6
973-21	30	20	80	370	500	25/9
1012-1A	35	20	120	430	1000	35/3
967-1A	35	20	150	200	1000	46/-
956-1A	30	20	200	160	1000	57/9
911-1A	30	15	250	160	1000	59/6
*983-1A	25	20/5	30/300	90	1000	65/6
986-1A	15	10	300	60	1000	62/6

★ **NOTE: 20% SALES TAX TO BE ADDED TO ABOVE PRICE**

★ **MOUNTING DETAILS:**

H—3H: Horizontal mount with steel louvred cover. Sub-terminal panel.
—8: Open steel clamps. Terminal strip prim. & sec.
—19: Horizontal 6in x 5in cast cover. Sub-terminal panel.
26—23: Open steel brackets. Terminal strips.
6—10—9: Diecast case with solder terminals.
—21: Open steel clamps. Terminal strips.
—22: Open steel clamps. Terminal strips.
—1A: Vertical steel louvred covers & leads.

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The lightning then jumps the gap in the spark cartridge and discharges safely to the fuselage.

Reporting to the American Institute of Electrical Engineers' meeting in Atlantic City, J. M. Bryant, University of Minnesota, and M. M. Newman and J. D. Robb, both of the Lightning and Transients Research Institute, Minneapolis, said valuable data have been gathered in the last two years by 50 of the devices placed on American Airlines craft.

Australian radio

SPECIAL aviation radio equipment manufactured by AWA Ltd. was featured at the world-famous Farnborough Exhibition, held annually by the Society of British Aircraft Constructors.

This was the first time an Australian company had been allotted a stand at Farnborough.

AWA managing director L. A. Hooke said, "This exhibition is the event of the year for aviation. Our Australian exhibit will show equipment that has not been duplicated elsewhere."

It included AWA double pulse distance-measuring equipment.

This is a radar-type navigation aid which enables a pilot to read, from a dial, distance flown or to be flown along a route.

Another exhibit showed "Condan", an anti-noise device making it possible for receivers to remain silent while operating in the presence of heavy static. The receivers are brought into action by the faintest signal.

A lightweight service pack was also featured.

It was specially developed for the armed forces in jungle conditions.

This radio set can be carried in two pouches on the signaller's waist belt for field communication.

Tiny motor

A TINY electric motor that you can mail for six cents has been designed to fit into standard aircraft instrument-cases only two inches in diameter.

Smaller than most women's thumbs, the precision induction motor is only 1.2in long, 5-8in in diameter, and weighs about an ounce. Its spinning armature has about the same diameter as a pea.

L. T. Akeley and J. R. MacIntyre, General Electric Co. engineers, told the American Institute of Electrical Engineers' meeting in Atlantic City that the motor works on two-phase, 400-cycle current, and that it has exceptional acceleration, stall torque and efficiency.

Jindivik as target

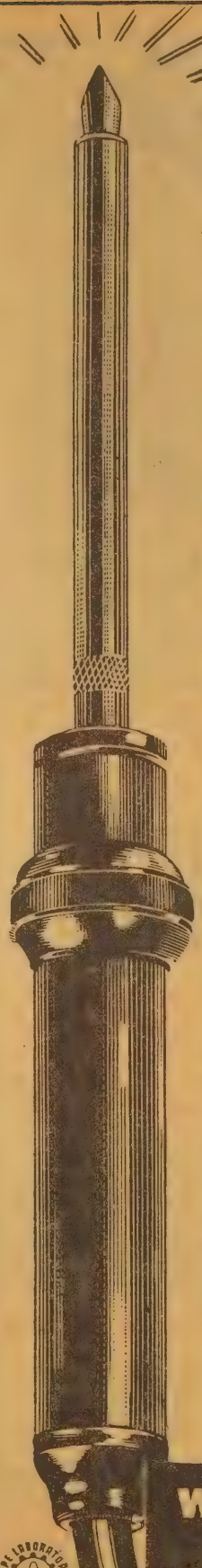
SHOOTING down of a Jindivik pilotless plane by a guided rocket is expected to be included in the tests at Woomera range.

The Jindivik, designed and built in Australia, will simulate a pilotless jet plane carrying atomic weapons over a city or industrial area.

Controlled from the ground, the Jindivik flies at near-supersonic speeds and is an ideal target for a radio-controlled rocket.

British Supply Minister Duncan Sandys said recently that he was very impressed by the Jindivik.

"It will enable trials to be carried out in something very much approaching operational conditions," he declared.



COMPARE THIS IRON WITH THE ONE YOU'RE USING!

Scope is a new type soldering iron that gives amazing soldering speed and efficiency whilst operating from low voltages, or from mains with transformer. To really appreciate the value of Scope you should test it yourself. If you do this, you will agree it is the soldering iron you should and must have. Visit your electrical supplier today.

SCOPE SOLDERING IRONS

CHECK THESE FEATURES:

1. Heats up in six seconds, and ready for continuous use.
2. Weighs 3½ ozs., 10-inch long; well balanced.
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4. Easy to use whether delicate or heavy soldering.
5. Is as efficient as iron rated to 150 watts.
6. Unique design assures that heat is applied only where and when it is required.
7. Switches off automatically when put down.
8. No necessity for frequent cleaning and tinning.
9. Replacement parts are easily fitted.
10. Scope is fully guaranteed.

RETAIL PRICE: Iron, 50/-; National Transformer, 47/11.

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VIBROSCOPE ETCHING TOOL

An extremely efficient, new type, etching tool. Combines mechanical vibration with electrical action. Indelibly marks ALL metals. Operates from Scope's Iron Transformer, or AC/DC sources between 3 and 4 volts.

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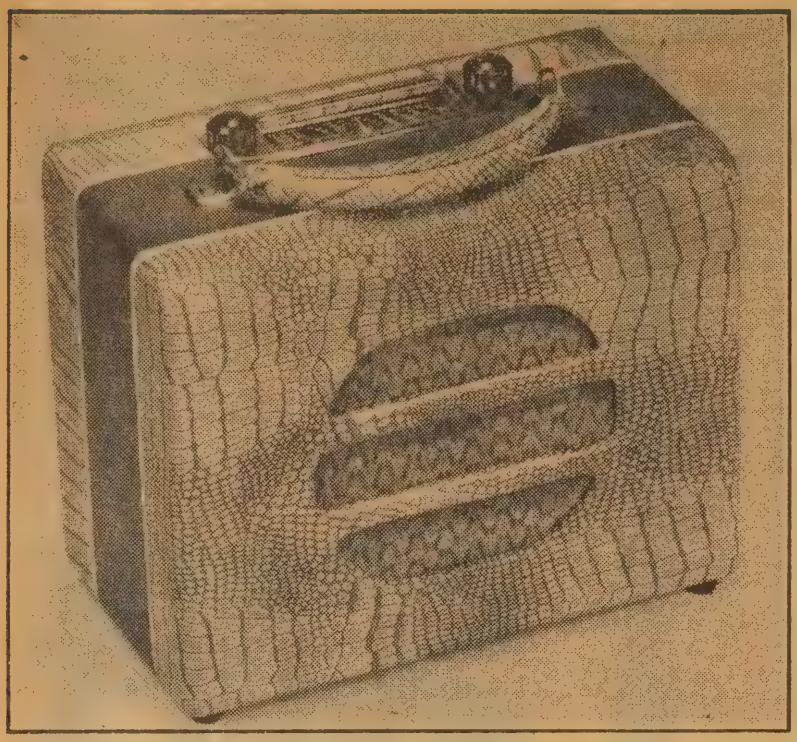


The finished set is housed in a particularly attractive cabinet. Note the "two tone" style and the white plastic piping. At the rear of the cabinet a fret similar to that at the front allows the sound to be heard from the back as well as the front. The set is smaller than our previous designs embodying a similar circuit.

PRESENTING THE R & H 'RAMBLER'

This time of the year always brings thoughts of portables and, if you are wanting something along those lines for your holidays, we submit our latest effort — "The Rambler". Using well-proven circuitry, it takes advantage of the latest components to reduce size without loss of performance. It is simple to build and the attractive two-tone cabinet gives it plenty of eye-appeal as well.

by Philip Watson

BEFORE setting out to design this portable, we conducted a miniature public opinion poll among dealers and others who normally handle such devices, in an effort to discover just which type of portable is the most popular.

As a result of this, we concluded that there is a definite swing away from the ultra-small personal portables in favor of the rather larger, more conventional portable, preferably using an RF stage. If such additional features as alternative operation from the mains, battery reactivation, &c., can be provided, so much the better, but these are not regarded as essential in the same sense as straight-out performance.

This trend away from the personal portable is not hard to understand. The final design of any portable is essentially a compromise involving such factors as sensitivity, power output, and reasonable quality reproduction on the one hand and operating economy, size and weight on the other.

In the design of personal portables there is every indication that the reduction of size and weight has overshot the mark; has been carried so far that sensitivity, power output and operating economy have been sacrificed to an unacceptable degree.

This fact may not be immediately apparent to the intending buyer or builder of a personal portable, who is initially intrigued by the fact that such a device can be carried on a shoulder-strap with little more effort than a camera. However, there is another side to the story.

To reduce size, the RF stage is invariably omitted, and this fact, coupled with the need to use a very much smaller and less efficient loop, results in a very serious loss of sensitivity. Around the city and suburban beaches this may not be serious, but take one a few miles out into the country and it can be virtually useless.

LIMITED VOLUME

Then there is the question of power output or, more correctly, the available undistorted volume. Size and weight dictate the use of a miniature 67.5-volt battery and this, in turn, restricts the available power output.

To make things really hard, we must now be content to feed this limited power to a 3in speaker, once again dictated by weight and space requirements. These devices undoubtedly represent a lot of hard work on the part of the engineers who designed them, but the unpleasant fact remains that, compared with larger speakers, they are woefully inefficient.

The net result is that the output valve is being driven well into the distortion region by the time the volume is raised sufficiently for more than one or two people to listen in comfort.

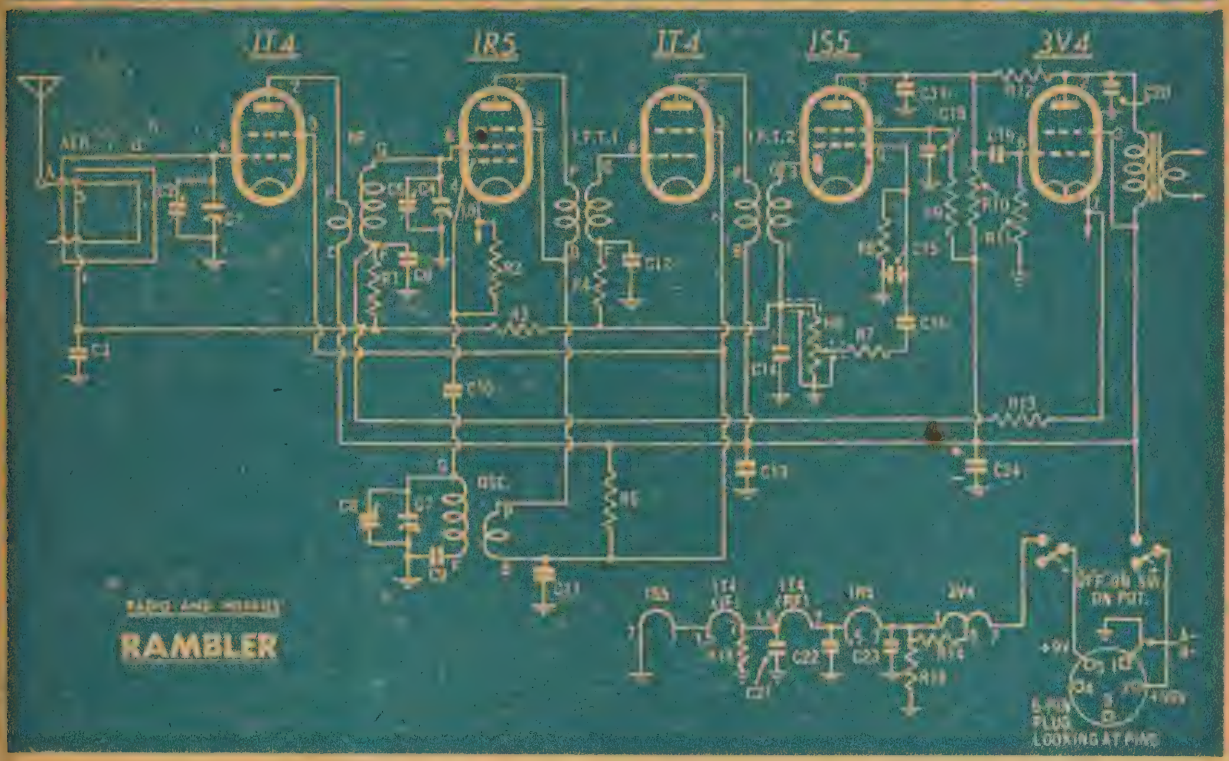
All this may sound a pretty severe indictment of the personal portable, but we are trying to place it correctly in the scheme of things.

If you are aware of all these limitations and still consider that such a unit will serve your requirements, then by all means go ahead and build, or buy, one. But having done so, don't complain when a more conventional design having a larger loop, larger batteries, larger speaker and an RF stage "leaves it cold" in a difficult location. What is more, there is nothing in the way of circuit design or components which will alter the position at the present state of the art.

Taking all these points into account, we decided that this portable would be one of the more conventional "large" variety, but incorporating such design improvements as the latest components permitted. The results, we feel, fully justify this approach, and the design looks like being a winner on all counts.

Although the size has been reduced

CIRCUIT CAN BE ADAPTED FOR MAINS OPERATION



The circuit should not present any difficulty to readers with a little building experience. Where a loading coil is employed in conjunction with the loop it is connected between the loop and the IT4 grid, or as advised by the makers. Note that the filament circuit is shown separately for clarity.

compared with previous models employing similar circuitry, there has been no significant reduction in performance. In fact, by arranging matters so that the sound emanates from both sides of the cabinet, much better use is made of the available sound and the rather unpleasant "boxed-in" effect of some designs is avoided.

The RF stage ensures plenty of sensitivity, even with the rather small commercial loop. Results should be even better with a larger loop wound to suit the available space, and we may have more to say on this point later.

PERFORMANCE

Tested on the roof of our building in the city, we had no difficulty in playing 2KA at a volume which drove the output stage to the point of overload. Newcastle and Wollongong stations could also be heard, though hardly at entertainment strength. These tests were made in daylight and without the aid of any auxiliary aerial or earth.

The cabinet styling is also worthy of comment. Beauty may be only skin deep and there is no doubt that a poor set remains a poor set no matter how it is housed. On the other hand, a good set becomes just that much better when it is housed in an attractive cabinet. We considered that this set deserved nothing but the best and accordingly approached one of our cabinet manufacturers for some ideas and suggestions which would do it justice.

We were particularly pleased with the result. Finished in an attractive two-tone style, using contrasting colored leatherette, and a discreet amount of white plastic piping it is a vast improvement on the older, more conventional, "one color all over" style. The cabinet has personality and color which are, unfortunately, not conveyed by the black and white picture.

All of which adds up to a very attractive portable. It is small enough to be unobtrusive and easy to handle but it retains the sensitivity and volume of a larger model.

One of the main factors contributing to the reduction in size was the use of a 5in speaker in place of the more usual 6in or 7in variety.

PARTS LIST

1 Chassis 5" x 5½" x 2⅜"
1 Cabinet 10¼" x 8¼" x 5 5/8"
1 Miniature 3 gang. AWA or similar
1 Dial MSL/48. Glass to suit gang
1 Miniature RF coil
1 Miniature BC oscillor coil wound on .1 meg resistor.
1 Loop aerial. Type M17A or similar
2 Miniature 455 Kc IF transformers
3 Miniature 7 pin valve sockets with shield
2 Miniature 7 pin valve sockets plain
1 5 pin socket with cover
1 5 pin plug with chassis mounting clip
1 5in permag speaker F5 or similar
1 Speaker transformer suit 3V4. Type GCL58 or similar
1 9 volt battery type 739
2 45 volt batteries type 482

VALVES

2 1T4, 1 1R5, 1 1S5, 1 3V4.

RESISTORS

R1, R3, R10 1 meg. ½watt
R2. .1 meg. ½watt (supplied with oscillator coil)
R4, R9, R11, R13, 3 Meg. ½watt
R5. 5000 ohm. 1 watt
R6. 1 meg pot. with D.P. switch
R7. .05 meg. ½watt.
R8, R12, 10 meg. ½watt
R14, R18, 400 ohm. ½watt
R15. 1000 ohm ½watt
C1, C4, C7. Gang sections
C2, C5, C8. Gang frimmers
C3, C6. .05 mfd 200V paper
C9. 425 pf 2½% mica
C10, C14 C15. 100 pf midget ceramic
C17. 50 pf midget ceramic
C11, C13 C21, C22. .1 mfd. 200V paper.
C12, C18. .01 mfd midget ceramic
C16, C19. .005 mfd mica
C20. .001 mfd mica
C23 25 mfd 40V midget electrolytic
C24 8mfd 150V or higher electrolytic
1 Plug to suit 739 battery
2 Plugs to suit 482 battery
2 3/16" spacers for dial
Tag strips. 1 8 term. (SM28), 1 7 term. (SM27), 1 3 term. (SM23), 1 2 term. (SM22).
Shielded hook-up wire.
7/.010 plastic hook-up wire
22g. tinned copper wire
1 mill. spaghetti
1 ¼" rubber grommet

HOMECRAFTS

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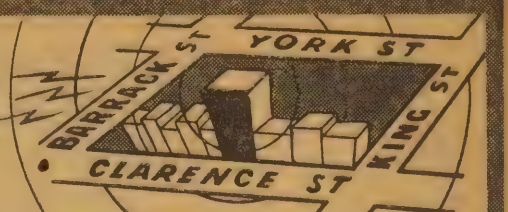

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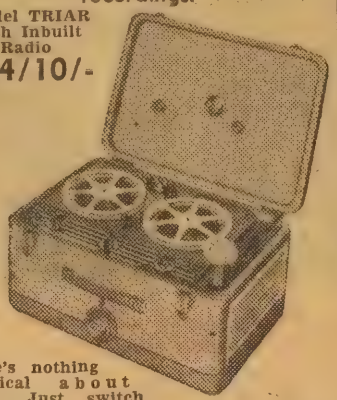
Now Available in two Speeds, 3¾in per sec. and 7½in per sec. giving 1 hour and ½ hour full track recordings.

Model TRIAR with Inbuilt Radio
£154/10/-



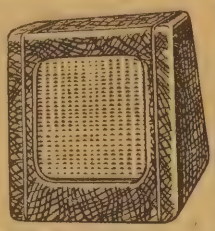
There's nothing technical about Elcon. Just switch on and away it goes. You can erase sounds from reel, record over and over.

£125

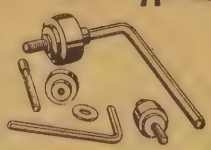
Model TRI/A (without radio tuner)

De-Luxe Extension Speaker

CABINETS — EXPANDED ALUMINIUM GRILLE.
Sizes 6in, 8in, 12in
For Rola speakers — leatherette covered.



Screw-Type Hole Cutters



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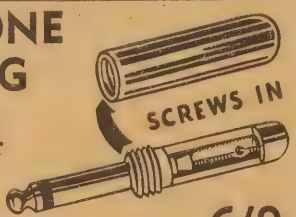

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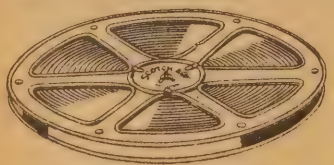

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This is made possible by the use of a recently released 5in model having much improved sensitivity, claimed by the makers to approach that of some 7in types.

This appears to be borne out in practice and little or nothing seems to have been lost by the change. On the other hand it does make possible a much smaller cabinet.

Another point which assisted in achieving a compact layout was the choice of separate filament and HT batteries rather than a combination block, the ability to distribute the batteries around the set making possible a more satisfactorily proportioned cabinet.

TYPE OF BATTERIES

While on the subject of batteries there is the question of customer reaction to the combination battery block. In many cases this appears to be unfavorable, the user considering that there is always the chance that he will not get the maximum life from one or other of the batteries.

Although both batteries are designed to have approximately the same life when used with an average portable it is always possible that one may have a few hours' life left. When separate batteries are used, the maximum life of each is obtained and the complete set of batteries need not always be replaced at once, thus conveniently spreading the cost.

The subject of batteries quite naturally leads to a consideration of the filament circuit and the relative merits of series and parallel connections. The parallel arrangement has the advantage of circuit simplicity, particularly in reference to the biasing and AVC arrangements in the RF and IF stages.

On the other hand a parallel network is not suitable for use with an AC operated power supply and, as we have some ideas in mind about this, we decided to use a series network together with the associated resistor and capacitor network necessary to provide the correct bias voltages and paths for the signals in each stage.

We were also influenced by the fact that the nine-volt battery intended for this type of operation (type 739) is smaller than the nearest equivalent 1.5 volt battery (type 745), thus making a further contribution to space saving. In an emergency, three type 701 cycle lamp batteries may be connected in series as a substitute and will fit easily into the available space.

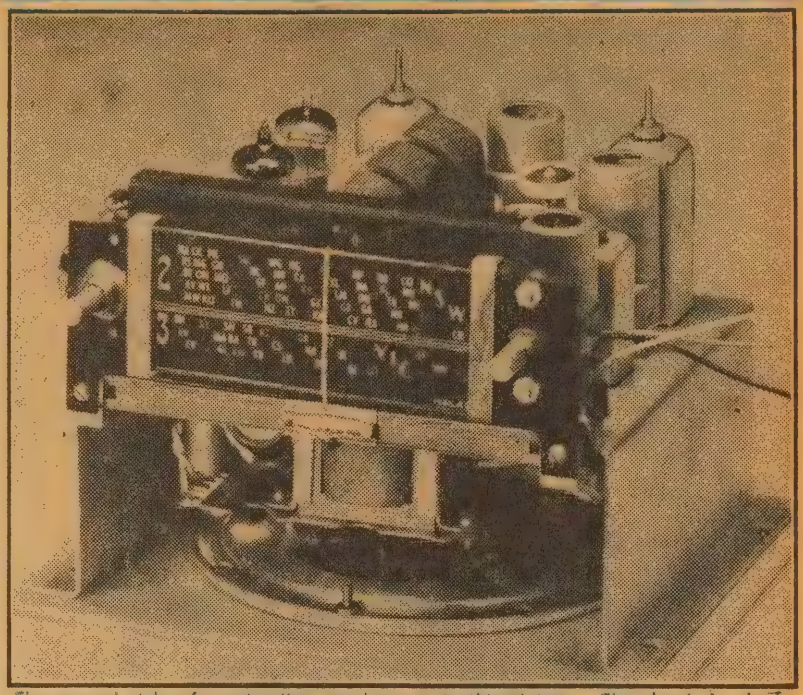
As can be seen from the photographs, the chassis is fairly deep and almost square, measuring 5in x 5¼in x 2 3-8in. The layout is so designed that the centre of the underside of the chassis is clear of components. This allows the set to sit over the top of the speaker, thus conserving space, while a cut-out under the gang allows the sound from the rear of the speaker to be heard through it.

GOOD LAYOUT

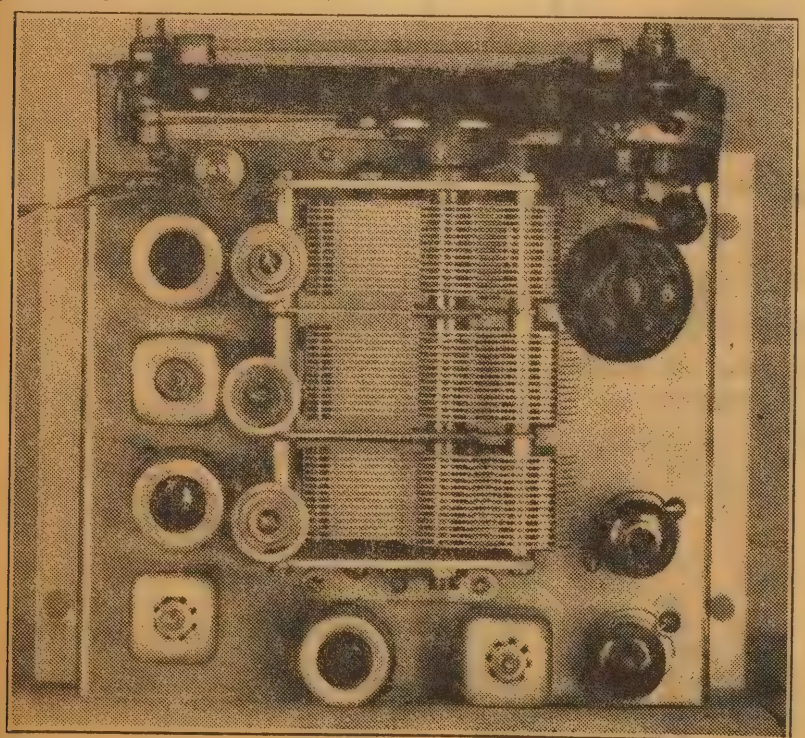
In spite of this slightly unconventional arrangement, the layout of the set is quite logical. Along one side of the gang is the 1T4 RF stage, the RF coil, the 1R5 converter, and the 1st IF transformer. Along the rear of the chassis is the 1T4 IF valve, the 2nd IF transformer, and the 1S5 diode pentode. Alongside the 1S5 and to the front of the chassis is the 3V4 output valve.

This arrangement makes it possible to keep plate and grid leads to a minimum length and takes the

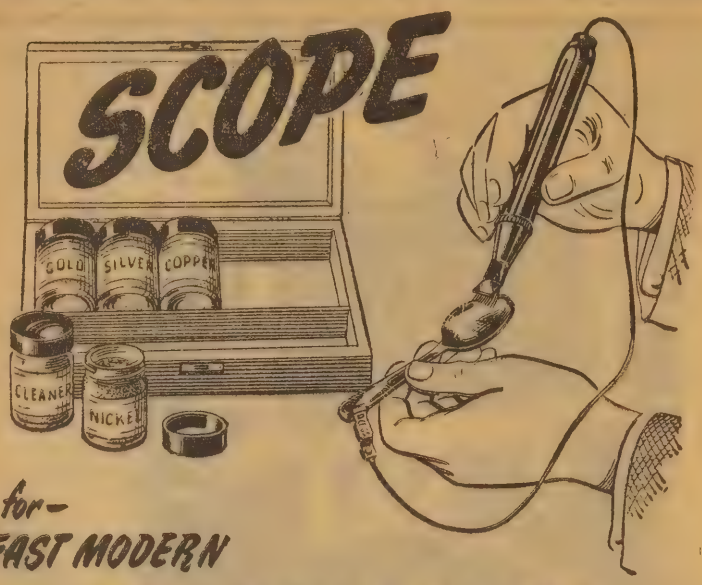
FRONT, TOP VIEWS OF NEW SET



The general style of construction can be seen in this picture. The chassis is wired with a clear space in the centre to accommodate the speaker, which can be seen beneath the dial. Front right is the RF valve, behind it the RF coil, the converter, and the 1st IF transformer, in that order.



This top view gives an excellent idea of the general layout. Along the right hand side, from the front, are the loading coil, RF valve, RF coil, converter valve, and first IF transformer. Along the back is the IF valve, 2nd IF transformer and 1S5. The 3V4 is alongside the latter.



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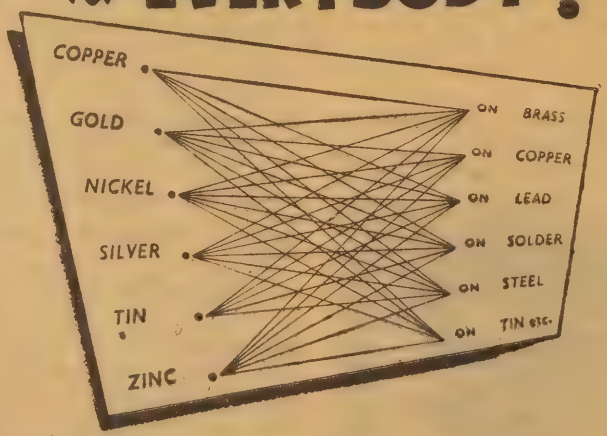

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signal through the set in logical progression with no doubling back.

A further improvement to the layout was the use of the centre section of the gang as the oscillator, thus separating the aerial and RF sections and, at the same time, locating each directly opposite its appropriate valve. The soundness of this arrangement was proved in the finished set, which showed no tendency to RF or IF instability, in spite of the high gain.

The loop gave us plenty of food for thought. Most commercially available loops are inefficient for two reasons, one that they are too small (dictated by the personal portable trend) and the other that the final inductance is very much an unknown quantity, being affected by proximity to other objects.

LOOP INDUCTANCE

A point which is not always fully appreciated is that the loop is essentially the aerial coil and must have the same value of inductance as an aerial coil if it is to be tuned accurately by the aerial section of the gang. If it does not possess the correct inductance performance will be seriously effected, particularly at the low frequency end where the compensating effect of the trimmer is no longer effective.

It is not sufficient that the manufacturer simply wind the correct number of turns on a former to give the required inductance because this value will be varied considerably by the loop's proximity to the chassis and batteries. This is one reason why manufacturers specify that the loop should be mounted at least ½in from metal objects.

One solution to this problem is the use of an adjustable loading coil. This is a small coil connected in series with the loop, its inductance, together with that of the loop being adjusted to equal that of a regular aerial coil. An adjustable iron slug in the coil allows the inductance to be varied over a moderate range and thus permit compensation for the mounting position of the loop. In practice, it is treated exactly as if it were a regular aerial coil.

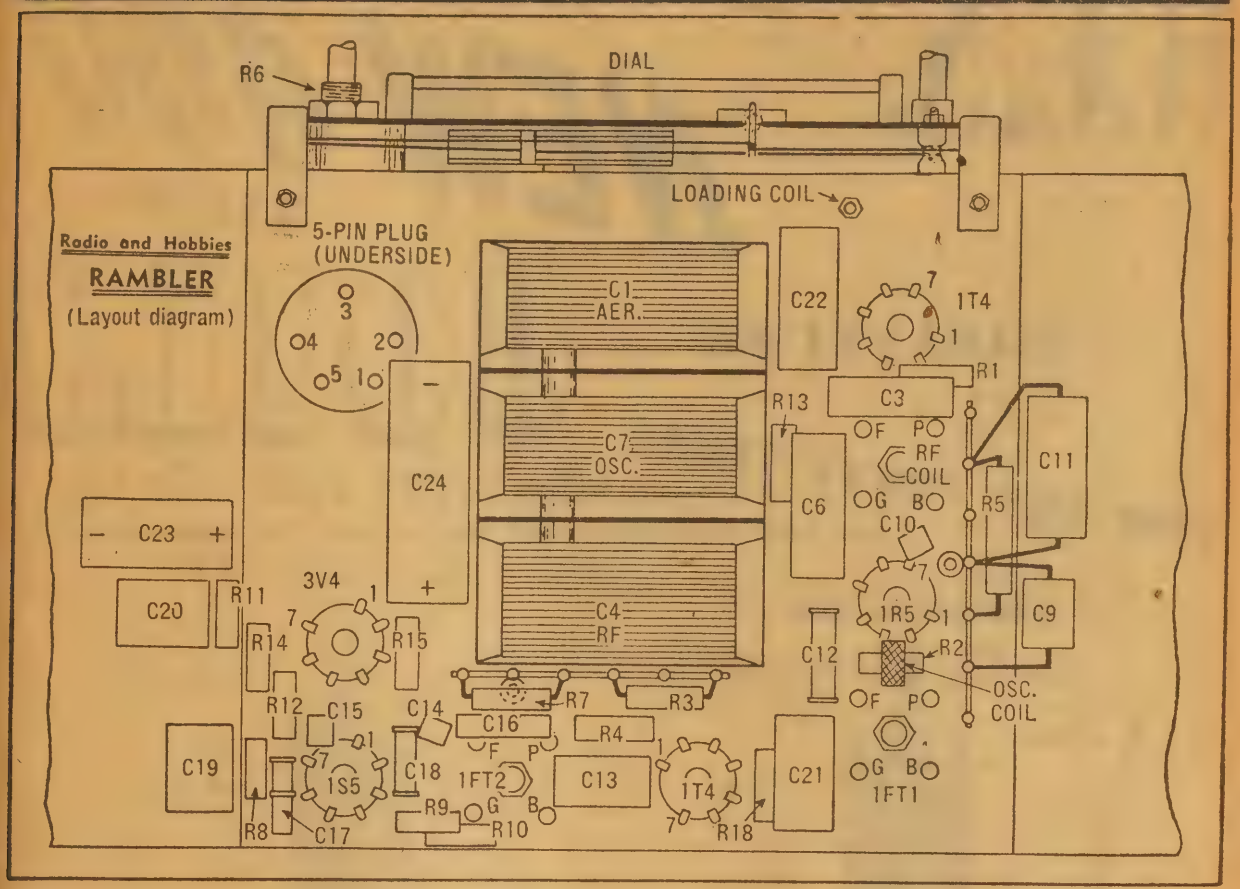
Another loop requirement is a "primary winding", similar to that on an aerial coil, which will permit a regular aerial and earth to be connected to it. This feature is valuable when the set is used in a really tough location and where there is no objection to the erection of a temporary aerial. Many camping sites would come into this category.

FINAL CHOICE

We searched the trade for a loop which would fulfil all these requirements and finally settled for the Aegis type M17A. It is not as large as we would like, but it looked to be the best available at the time of writing. We hope to conduct some experiments in winding a larger loop and will pass the data on when it is available. However, as intimated earlier, performance from the M17A is quite satisfactory for all but perhaps the most exacting requirements.

Although excellent electrically, the loop needed some mechanical modifications to make it suitable for our particular set-up. One of our main requirements was that the speaker should be audible from the back of the cabinet as well as the front and

DIAGRAM SHOWS RECOMMENDED PARTS LAYOUT



This layout diagram shows the position of the various components and the orientation of the valve sockets and coils. Used in conjunction with the circuit diagram it should enable an exact copy of the original to be made. The components are not necessarily drawn to exact scale.

the loop, wound on a large canvas bakelite former, threatened to block this if mounted in the most logical position.

We overcame the problem by cutting a rectangular opening in the centre of the former, measuring approximately 2 5-8in by 3 5-8in. This was about as large as was feasible and proved quite adequate in allowing a free passage of sound. All but one of the solder lugs terminating the loop connections were removed by this procedure, but these were easily replaced by rivetting new lugs on the remaining material. If rivets are not available small nuts and bolts could be used.

THE LOADING COIL

A new place also had to be found for the loading coil and this was mounted on the chassis proper. This has the additional advantage of providing a firm mounting which makes adjustment much easier. It is mounted in front of the RF valve and is close to the appropriate gang section. A two terminal tag strip alongside it provides termination for that end of the winding which goes to the loop. The other end goes straight to the gang terminal.

To mount the loop we cut a false back from 3-16in ply and fitted it into the back of the cabinet. This also had a rectangular opening cut in it, corresponding to that in the loop former. The top corners were also cut so as not to foul the lid clasps.

The only other components likely to obstruct are the adjusting screws in the first IF transformer and loading coil, and the top of the dial. Two holes in the ply provided clearance for the screws and a single layer of ply was removed from the dial area with the aid of a sharp knife.

Another job for the false back is that of steadying the HT batteries, which may tend to move about slightly in the space available. To prevent this, two small wooden blocks should be mounted on the ply and adjusted so that they exert slight pressure on the batteries. Suitable dimensions would be 2in x 1in x 1 3-6in.

The loop proper was attached to the ply with nothing more elaborate than two drawing pins, though nuts and bolts or small tacks could be used. It is advisable to drill the canvas bakelite to take these as it may split if they are driven through it. Before finally locating the loop on the ply and cutting out the opening make sure that both the trimmers and the loading coil slug are accessible for adjustment.

It will be seen from the circuit that the loop primary winding has no direct earth connection. This is as the loop is designed, and it appears to give the best results. However, an earth connection is desirable in difficult locations and this should be made to the chassis proper.

To provide the connections for the auxiliary aerial and earth we simply provided two short lengths of hookup wire which could be tucked away behind the lid when not required. Tip jack sockets could be fitted to the lid if desired.

SPEAKER MOUNTING

The speaker is mounted on a baffle of 3-16in ply and this is held between the front of the cabinet and the chassis. The chassis is attached to the front of the cabinet by means of two machine screws which will be fitted to the cabinet before it is covered. These are 1-8in diameter and should protrude from the wood by ½in. They are held

TO provide further assistance for those who may wish to build this set we are arranging that ORIGINAL PHOTOGRAPHS, reproduced on these pages, be made available through our query service. The price per photograph will be 4/- for a 6in. x 8in. glossy print. This is an experiment and if it proves popular we may be able to extend it to other projects.

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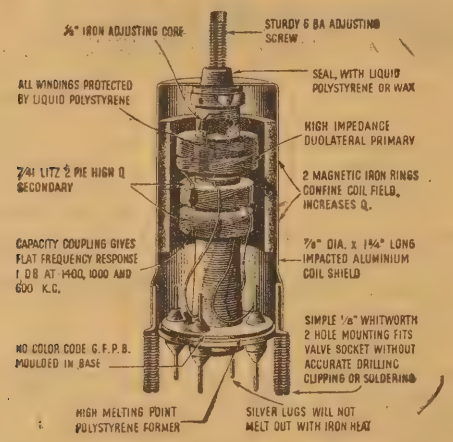
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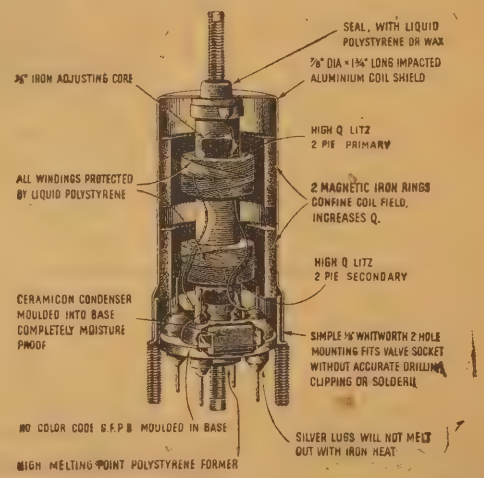
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in place with a nut and the baffle must be drilled to clear this and lie flat against the front of the cabinet.

The speaker is mounted so that the transformer is toward the front of the chassis and so located that the magnet does not foul the tag strip mounted on the rear of the chassis. To facilitate connection to the transformer, particularly during the initial testing period, a three terminal tag strip is mounted under one of the transformer mounting bolts and used to terminate the transformer primary leads.

Selection of the correct transformer type is important since the available space is limited. The ideal choice appears to be the type "F", No. GCL58, which is a 10,000 ohm impedance primary designed for operation with the 3V4 valve.

THE DIAL

The dial is similar to the one used for the Kar Set and the Jubilee Portable. It is small enough to permit a compact construction, but large enough to accommodate a reasonable number of station markings.

The two mounting brackets are attached to the underside of the chassis, but spaced away from it by two 3-16in spacers. If spacers are not available, washers could be used and a certain amount of final adjustment is possible by bending the mounting brackets slightly. The dial as supplied will have the drum attached to the main plate by means of a screw. This is only a temporary mounting and should be removed when the dial is mounted and the drum fitted to the gang shaft.

The shaft on this dial is rather short, and, to provide enough length for a standard knob, and also to bring the dial glass as close to the escutcheon as possible, we have specified that the cabinet should be routed to a maximum thickness of approximately 1-8in in this area. This allows the whole set to move upward and provides ample shaft length.

The gang is an AWA miniature type, and, since this is one of the larger miniatures, there should be plenty of room to use smaller sizes. However, some additional brackets may be necessary to accommodate them over the sound aperture in the chassis. This will not be a problem for the builder who makes his own chassis, but will need to be considered in the case of a ready-made one.

In order to mount the AWA gang as close to the chassis as possible, it is necessary to modify the mounting brackets slightly. Two new holes are drilled in the vertical section, as close to the horizontal section as possible. The surplus vertical portion of the bracket must be cut off to prevent it fouling the gang bearings.

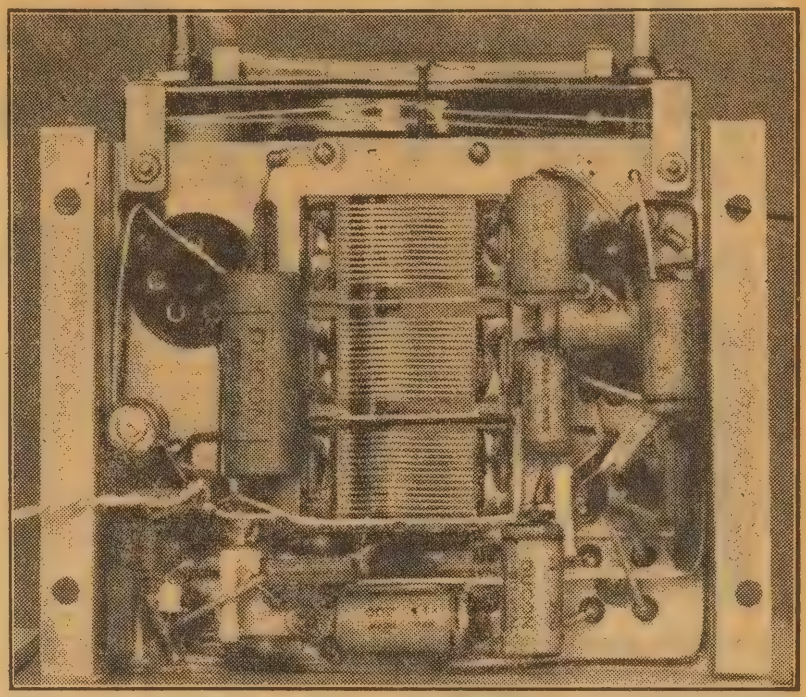
ASSEMBLY DIAGRAM

The mounting of the remaining major components, valve sockets, IF's &c., calls for some care if they are to be correctly orientated for minimum lead length. To assist in this regard, we have prepared an assembly diagram giving this information as well as the position of other major components. This, in conjunction with the photographs, should provide all the information necessary to permit the original to be copied.

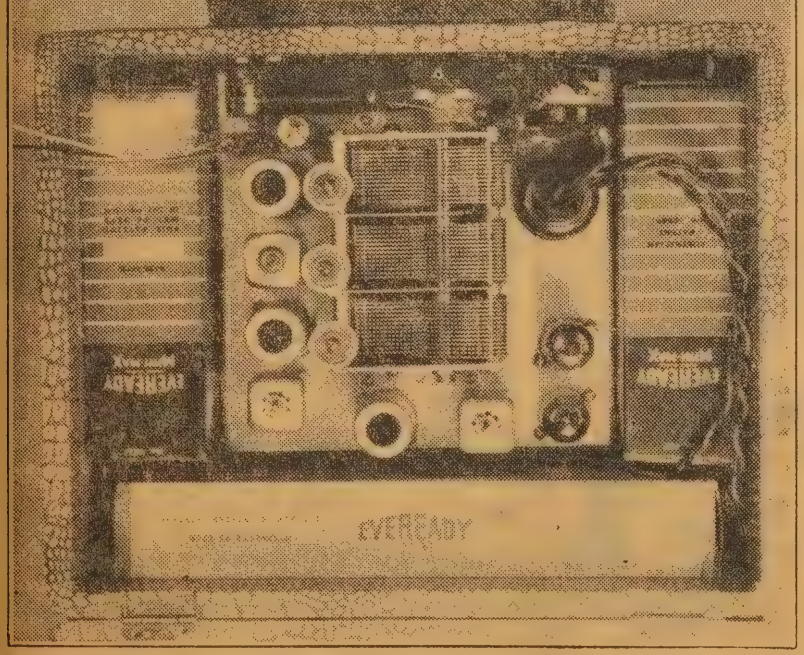
This brings us to the actual wiring. The first step is to wire the filament circuit, using the separate diagram in the circuit.

As well as the actual series connections of the valve filaments the associated components, shunt resistors and by-pass capacitors, should be fitted. The only exception is the 25 mfd by-pass from pin 1 of the

UNDERNEATH VIEW OF CHASSIS



An underneath shot showing the layout of the smaller components. Some of the capacitors may be available in slightly smaller types which will make the layout a little simpler. Note the audio components against the side of the chassis. Arrangements are being made to supply original photographs through our query service.



This picture shows the arrangement of the chassis and batteries in the cabinet. The leads to the loop may be seen leaving the right hand side of the cabinet. When completely assembled, the loop mounts on a false back covering all but the centre of the chassis.

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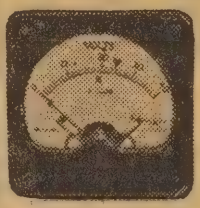

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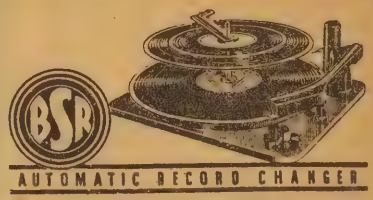

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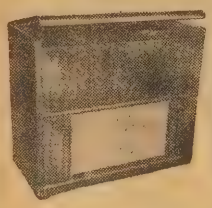

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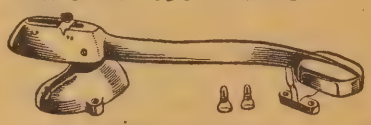

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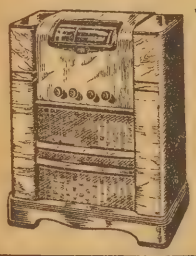

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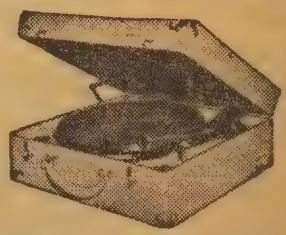

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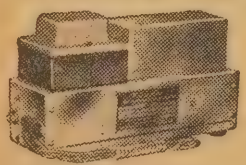

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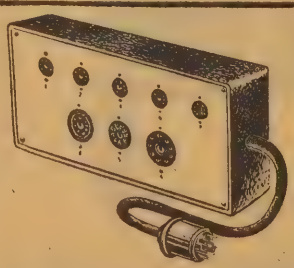

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3V4. This is best left until most of the other wiring is completed.

It is a good idea to wire the filament circuit with a distinctive color, thus assisting to check this part of the circuit if it should be necessary.

It is also advisable to run an earth wire of tinned copper wire around the chassis to avoid the possibility of poor earths when using a steel chassis. Solder lugs should be placed under each socket mounting nut and an earth wire run around the inside of the chassis near the gang cut-out, commencing at the 1T4 RF valve socket and finishing at the appropriate pin of the chassis mounted five pin plug. At the same time the central spigots of each valve socket should be earthed.

FRONT END WIRING

Next the wiring around the RF and oscillator stages can be commenced and the obvious short connections made. For such connections light tinned copper wire, about 22 gauge, covered with 1 mill. spaghetti tubing, is very convenient. Connections should be "point to point", without any fancy bends, where ever plate and grid leads are involved.

The wiring around the oscillator valve socket (1R5) also includes the oscillator coil and a few points about it are worth noting. This is an unshielded coil wound on a .1 meg. ½ watt resistor. This resistor becomes the oscillator grid resistor (R2) and the whole assembly is mounted by simply connecting the resistor between pins 1 and 4.

One lead from the oscillator coil goes direct to pin 3 of the IR5, while the remaining three leads are terminated on a tag strip. This is a 7 terminal strip (SM27) which is mounted near the side of the chassis by means of the bolt holding the IR5 socket. It also serves to carry the screen and oscillator plate dropping resistor (R5), the .1 by-pass (C11) and the padder (C9).

The terminal nearest the front of the chassis serves to terminate the AVC lead from the loop, and one end of the AVC by-pass (C3) and the AVC resistor (R1).

Before mounting the tag strip in place, it should be fitted with three short lengths of hook-up wire. Two go to opposite ends of R5 and the other to the AVC terminal nearest the front of the chassis. They should be long enough to reach their respective parts of the circuit.

HOOK-UP WIRE

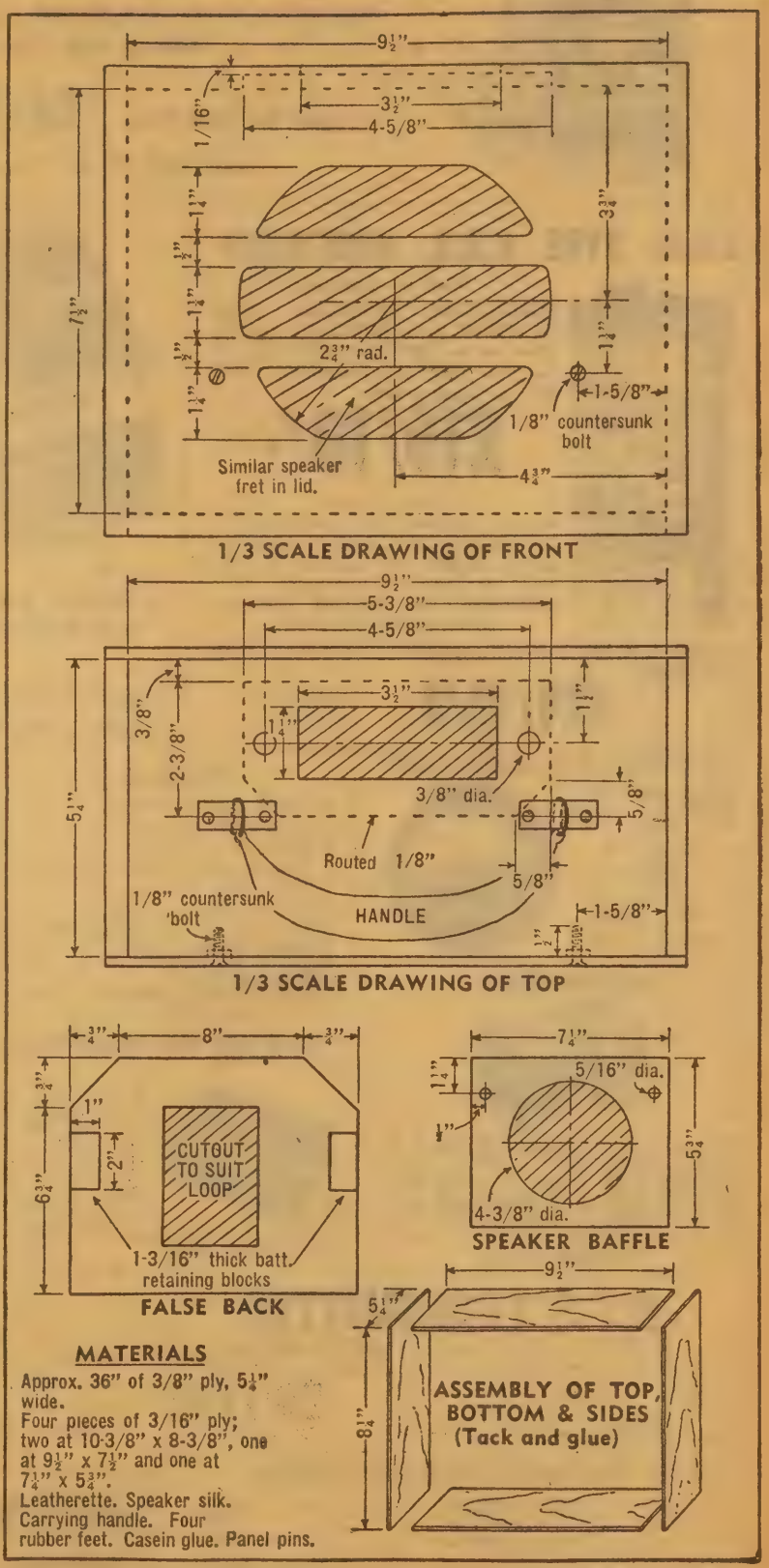
A light gauge hook-up wire is desirable for jobs of this kind and the plastic covered variety known as 7/.010 appears to be about the best. Heavier gauges are likely to be difficult to handle.

A second tag strip is mounted toward the rear of the chassis flush with the rear edge of the gang cut-out. It is an eight terminal type (SM28) from which two terminals (including one mounting terminal) have been cut. This makes a six terminal strip with a conveniently located mounting lug. On this is mounted the decoupling resistor in the 1S5 grid circuit (R7) and the 1 meg. AVC resistor (R3).

The volume control mounts on the dial plate in the hole provided for it and this component also incorporates the on-off switch. This breaks

(Continued on Page 97)

DETAILS OF "RAMBLER" CABINET



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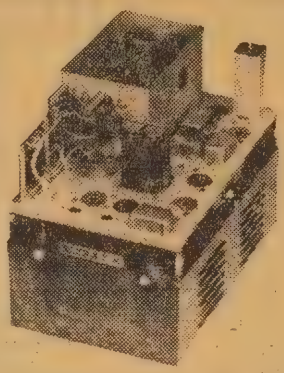

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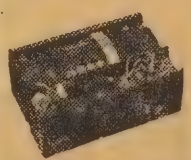

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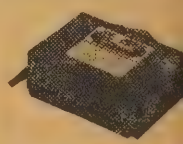

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Here's your answer, Tom!

If you have studied your valve data book as we suggested, Tom, you will have come across a number of seemingly peculiar valve types that so far we have not mentioned. Duo-diode triodes, duo-diode pentodes, twin triodes, pentagrid converters, triode heptode converters and others. Just in case you have decided that the valve people are deliberately trying to be confusing, we will have something to say about multiple types this month.

FIRST of all, Tom, let us have a look at these duo-diode triodes and duo-diode pentodes. (If you take me literally, so much the better.)

We have already talked about the use of diodes, triodes and pentodes separately and you should understand their respective functions.

To revise the position briefly again, diodes are valuable because of their property of passing electrons in one direction only. They can be used to rectify radio frequency signals so that the modulation impressed on the carrier wave can be extracted and passed on to an audio amplifier.

Triode valves have a wire grid inserted between the cathode and plate and this grid is able to control the flow of electrons with practically no expenditure of energy on the part of the controlling source.

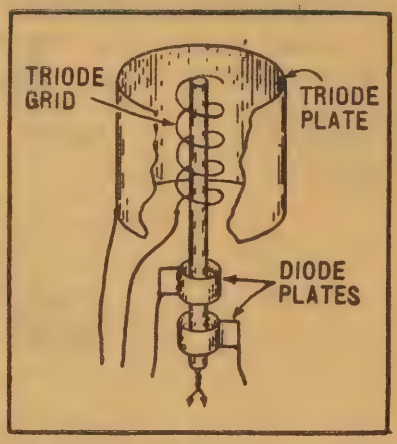
The proximity of the plate and grid make the triode valve unsuitable for amplifying radio frequencies. A closely wound screening grid which is placed between the control grid and the plate overcomes this difficulty. At the same time, however, it introduces unwanted secondary emission from the plate and to obviate the ill effects of this, yet another grid is inserted between the screen and plate. The valve then has a total of five elements and goes by the name of pentode.

HIGH AUDIO GAIN

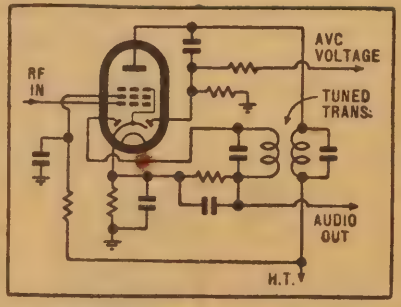
Not only is the pentode an excellent radio frequency amplifier but its characteristics allow it to give greater gain than the triode as an audio frequency amplifier where this gain is needed.

A workable small receiver could consist of a pentode radio frequency amplifier, a diode detector and say a triode audio frequency amplifier followed by a pentode audio frequency amplifier. The last amplifier, of course, would operate the headphones or loudspeaker. A pentode could be substituted for the triode following the detector, should the extra gain be needed, but in many cases the gain of the triode followed by the pentode is all that could be usefully employed.

Diodes of the type used for detection and automatic volume control are very simple and can be made very small. Two diode elements can be placed in the one small envelope if desired. One can be used for detection in the normal way and the other can be used as an AVC rectifier.



Because detector diodes and AVC diodes can be made very small, they are easily accommodated in the same structure with a triode or pentode unit.



A typical circuit arrangement showing how the diodes and pentode in a single valve structure function to provide high frequency amplification, detection and AVC voltage

This arrangement allows a rather interesting refinement to be made to the AVC system.

When listening for a very weak station amid a lot of noise, it is desirable that the AVC system not operate at all so that the maximum gain of the receiver can be put to good use. With an ordinary automatic volume control system, even the noise develops some AVC bias and reduces the gain of the receiver slightly.

The separate diode allows a small fixed voltage to be applied in series with the AVC diode so that it is not able to conduct until a certain minimum voltage is exceeded. The amplification of the receiver is therefore not reduced until a signal of predetermined level is received.

Typical examples of twin diodes are the 6H6, 6H6-G and 6H6-GT. They are all identical in their electrical characteristics, but have different outside appearances. The 6H6 has a metal envelope and sits only about 1in above the chassis. The other two have glass envelopes of different sizes, the 6H6-GT being the smaller of the two. A twin diode in the new all-glass miniature series is the 6AL5. It is otherwise similar to the 6H6.

IN OTHER VALVES

Diodes for detection and AVC being so small and their simple construction leaving little to go wrong, it was found convenient to place them in the same evacuated envelope with pentodes and triodes used for amplification at radio or audio frequencies. The cost of equipping a receiver with a full complement of valve types was thereby reduced appreciably.

The diode elements may use the same cathode or filament as the triode or pentode section and the circuitry can be arranged so that bias can be applied to the triode or pentode unit independently of the diodes. Again, by a simple trick of wiring, the detector diode can be made independent and the AVC diode connected so that the cathode bias for the amplifier unit is also used as a delay voltage.

A popular double-diode-triode is the 6SQ7-GT. It is the modern equivalent of the 6B6-G and 75. The triode element is designed to give high gain as an audio voltage

Multiple Valves...

amplifier and can be fed into a power amplifier valve supplying a loudspeaker. Although the triode does not give as much gain as the pentode, it is often more than sufficient and the screen dropping resistor and bypass condenser are not required.

Where the extra gain is required the 6B8-G, which is a duo-diode (double diode) pentode, can be used. The pentode section of the 6B8-G can be used to amplify the radio frequency signal before it is applied to the detector if desired. Some other arrangement of valves can then be used in the audio amplifier.

In most cases of a radio frequency amplifier it will be desired to apply AVC so that a variable-mu characteristic is required. The 6G8-G is a suitable type. It is generally similar to the 6B8-G except for the variable-mu characteristic.

DIODE-OUTPUT VALVE

The latest all-glass miniature series of valves includes type 6BV7, which is a duo-diode power amplifier pentode. The two diodes are used for detection and AVC rectification following a radio frequency amplifier as before but, instead of passing through a voltage amplifier, the audio signal is applied directly to the power output stage.

The pentode section of the 6BV7 has a particularly high sensitivity and this arrangement is satisfactory for smaller receivers.

There are other examples of the combination of diodes and other amplifying valves, but the above will give you a good idea of what can be done.

A special point of interest arises when diode elements are included in battery valves which have a thin filament as the electron emitter rather than a cathode in the form of a sleeve. A potential must be applied between the ends of the filament in order that the heating current pass.

It is often convenient to place one of the diode plates near the negative end of the filament and the other near the positive end so that the actual cathodes of the two diodes are at a substantial potential difference. The negative end of the filament is usualy earthed and the diode near this end used for detection.

DELAY VOLTAGE

The diode near the positive end of the filament cannot conduct until the voltage applied to it exceeds the filament voltage of the valve or almost that amount. It can therefore be used as an AVC rectifier and will provide a delay voltage equal to the filament voltage of the valve.

Experience has shown that it is not wise to attempt to combine too many valve structures in the one envelope, especially these days when individual valves are not very big anyway.

One type, which has now fortunately been superseded, is the 1D8-GT. It is a 1.4V filament battery valve combining a diode, a triode and a pentode output valve. Should the frail filament serving one section of the valve break or a fault occur in any part of the valve, the unfortunate set owner is put to the expense of replacing the complete unit. Fortunately, since the time when the 1D8-GT was used in new sets, battery valves generally have become more reliable.

Two triode units are often combined in the one envelope and the 6SN7-GT, 6SL7-GT, ECC33 and ECC35 are examples. Some have high amplification factors and some have medium amplification factors depending on the job required of them. Modern industrial electronic equipment has brought the new miniature twin triodes such as the 6J6, 12AT7 and 12AX7 into prominence.

Large diodes suitable for rectifying the AC mains before being applied to the plates of the other valves are sometimes included in the same envelope as a power output valve. Few of these valves have been seen in this country. Manufacturers are not keen to tool up for their production because they merit similar criticism to the 1D8-GT and valve users are well served by currently available types.

The pentagrids, triode-heptodes and others we have yet to mention are used for frequency conversion in a special type of receiver known as a superheterodyne. We will have something to say about the superhet in next month's discussion.

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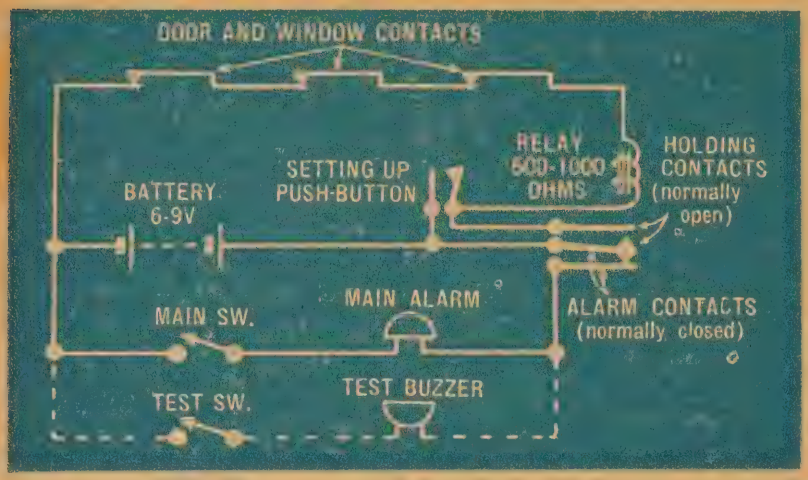


The basic principle of the complete system can be understood from this circuit. Main feature is the closed circuit system and the provision of the holding contacts on the relay. The setting-up button is convenient and protects the relay contacts.

INSTALLING A BURGLAR ALARM

THIS description is based on an actual installation which the writer decided to fit to his own home after two visits by the disciples of Bill Sykes. Anyone who has been in a similar position will appreciate the nasty taste it leaves in the mouth. Those who haven't can take my word that the experience is not a pleasant one, even if the value of the property lost is not great.

Most domestic alarms work on the principle of providing a very loud alarm, usually outside the house, though well hidden, which will be clearly audible at least to neighbors on either side and preferably further away than this. Whether such neighbors are willing or able to summon assistance when the alarm goes off is really of little importance, because no prospective burglar will wait around to find out.

HURRIED DEPARTURE

Most of them will cover the first hundred yards in even time, fences and other minor obstacles notwithstanding.

An alternative arrangement is one where it is desired to provide protection for a building remote from the main residence, such as a lock-up shop, garage, "ham shack" or workshop. In this case it is preferable to provide a small bell, or even a buzzer, which will be audible only within the residence.

In these circumstances an intruder need not know that his presence has been detected until a man in blue appears at his side and begins to ask certain awkward questions. Police officers to whom I have spoken on the matter agree that such systems result in a high percentage of catches.

It is usual with such systems to provide a large outdoor bell which can be switched into circuit when both premises are unattended, thus providing protection by the "scare" method.

Many commercial systems provide what might be termed the ultimate in protection by connecting each building to be protected to a central switchboard, manned continuously by officers of the company providing the service. Connection from the building to the switchboard is by means of telephone lines provided by the PMG's Department and the occupier of the premises pays an annual rental for the entire service.

Schemes like this, of course, are outside the scope of the amateur, but are mentioned as a matter of interest.

Coming back to more practical considerations for a domestic circuit we have to consider first whether to use a closed circuit or open circuit system. There are points in favor of both systems, though the closed circuit system seems to be the one generally preferred.

The open circuit system is one where the alarm bell is connected directly to the various door and window contacts so that the closing of any set of contacts, by opening the door or window, will cause the alarm to ring. Various schemes are used to ensure that the bell will keep ringing, even if the circuit is opened again immediately.

DISADVANTAGES

The disadvantages of the scheme may be summarised as follows: Vital wiring of the system must be taken to each possible entry point, thus creating the risk of the system being rendered inoperative by a would-be intruder cuting the wires or tampering with the contacts. In a commercial installation this may not be serious if the wiring can be carefully concealed, while the use of properly hidden contacts provides additional protection.

A further safeguard is the use of twin cable in the one covering, as any attempt to cut this would almost certainly short the two conductors momentarily, thus starting the alarm.

The second point is the possible failure of a particular set of contacts to close the circuit properly and, to ensure that the system is always working, it is necessary to test all the contacts at fairly frequent intervals. Many non-technical owners do not fully appreciate this and are content to test the circuit by opening an odd door or window and being satisfied if the alarm operates.

On the credit side it must be pointed out that such systems are less prone to false alarms than other systems, as well as being lighter on battery current. In fact, the batteries should have a life almost equal to their shelf life, since they will have only a brief drain imposed on them for testing at fairly well-spaced intervals.

CLOSED CIRCUIT PROBLEMS

In all fairness it must be pointed out that the closed circuit system also has its disadvantages as well as advantages and a brief discussion on these points may be helpful. The closed circuit operates on the principle of using a circuit through the window and door contacts to hold in a relay. A pair of normally closed contacts on the relay are thus held open and, since they form part of the main bell circuit, the bell is prevented from ringing.

Opening a door or window will open the relay circuit, allow the relay to drop out, and close the main

★

This article was prompted partly by requests from readers and partly by some caustic comments which the serviceman made recently about a system he encountered. The double reminder caused us to search out someone who had had some experience with such devices and the result is a description of a typical installation which any amateur should be able to install.

★

bell circuit. As with the open circuit system the bell will continue to ring until a local circuit is interrupted. Obviously there is little chance of the contacts failing to operate, while a cut wire will also operate the alarm.

On the other hand, the natural tendency is to a false alarm if the contacts are faulty and too many of these can nullify the whole purpose of the scheme. Since there is a continuous drain on the batteries while the system is set up they will have a much shorter life, though most people still consider that the few pence a week running cost is cheap insurance.

All things considered, and assuming that the weak points of the system are recognised and allowed for in designing the installation, it seems that the closed circuit system is to be preferred.

The accompanying circuit will give some idea of the practical application of the principles just explained. It will be seen that the battery, door and window contacts, the relay coil, and a set of contacts on the relay all form a series circuit. The purpose of the relay contacts is to provide the continuous ringing feature and their operation is quite easy to follow.

OPERATION

Assuming for the moment that the relay is being held in, it can be seen that the current through the coil must flow through the relay's own contacts in order to hold it in. In other words, the contacts are what are known as "self-holding" contacts. It is easy to appreciate that such a relay cannot pull in again once it has dropped out, because it will have opened its own coil circuit. Thus, once the alarm is started, it cannot be stopped by simply restoring the contact circuit.

Obviously, some method must be provided to cause the relay to pull in whenever the system is to be set. One way would be to simply push the relay in by hand, but this has the disadvantage that the relay may not always be conveniently located, plus the far more important problem of protecting the relay contacts.

Because of the inductive nature of the circuit, due to the relay coil, considerable sparking can occur when the circuit is broken. Theoretically, this should not be a problem when the relay is being pushed in but, in practice, it is possible for the current to vary both up and down at the moment of contact, particularly if the person concerned does not appreciate the need to make a quick and positive movement.

SETTING UP BUTTON

A far better arrangement is to connect a push button across the holding contacts so that they are momentarily short circuited as the button is pressed. This causes the relay to pull in, holding in on its own contacts when the button is released. This enables the holding contacts to operate under the ideal conditions of never having to either make or break a circuit, the make occurring through the push button and the break at whatever set of contacts are broken first when unsetting the system.

This is important because failure of the holding contacts could cause a false alarm.

In setting the system, therefore, one simply makes sure that all the windows and doors are closed, that a method of exit from the building has been provided (more about this in a moment) and then presses the relay setting button. If all contacts are closed the relay will be heard to pull in, after which the main bell switch may be closed and the system is set.

UNSETTING

To unset the system it is only necessary to open the main bell switch, the relay automatically dropping out with the first window or door opened.

The next point to be considered is how to get out of the building without setting off the alarm or without leaving a vulnerable point in the form of an unwired door. Two schemes suggest themselves; one to provide a special switch temporarily to short the door contacts, and the other to provide a socket into which a shorted plug may be inserted to achieve the same object.

Commercial installations usually provide a multi-position switch on or near the main entrance door, and which must be set to a particular position in order to short the contacts. In use, the switch is set to a reference point, such as a stop, and then clicked up to the appropriate number for the particular system.

Since an intruder can only have one chance to beat such a combination, it is unlikely that he could pick it in one attempt, even assuming that he is familiar with the system. In general, this will not be so.

In the event of anyone learning the number accidentally, it is a simple matter to change it, or it may be changed at regular intervals as a matter of course. The switch should be accessible from inside, as well as outside, in order that the door may be conveniently set from the inside on the way out. Otherwise it must be set first and then the relay set up, an arrangement which is not quite so convenient.

Although commercial installations use special switches, there is no reason why the amateur should not use the multi-position radio switches and an 11-position, single pole, is ideal. The type chosen should have a long shaft in the front to pass through the door or other woodwork on which it may be mounted.

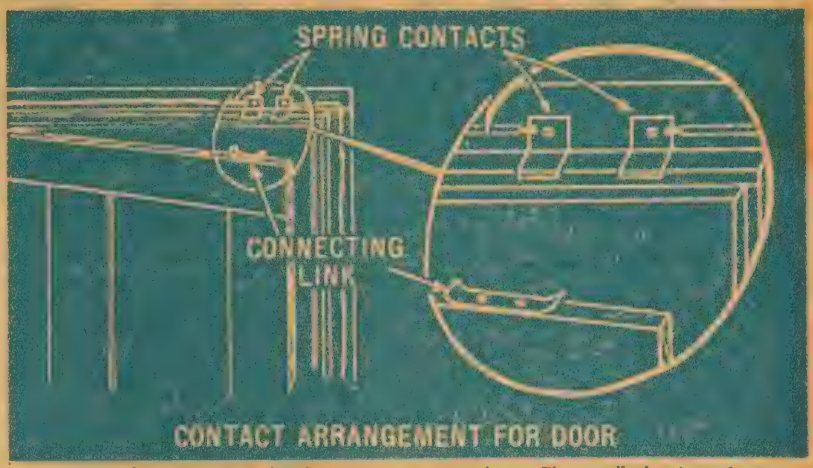
SWITCH COVER

A metal cover should be mounted over the switch proper to prevent prying eyes from discovering what it is all about or the number which has been selected for the system. To facilitate the fitting of a knob on the inside, the switch should have sufficient length of shaft to the rear to pass through the cover with about ¼in to spare. If such a switch is not available, it may be necessary to fit an extension shaft of some kind.

The other alternative, the plug and socket idea, may also appeal to readers. The simplest arrangement would simply use a two-pin socket of some kind, mounted as unobtrusively as possible, and into which would be plugged a shorted plug whenever required. A better scheme would be a multi-pin socket, such as an octal, with an appropriate plug.

Quite an elaborate system of cross-connections between the plug and socket is thus possible, and it would be virtually impossible for anyone

CONTACTS FOR WINDOWS, DOORS



A suggested arrangement for fitting contacts to doors. The small shorting piece on the top of the door presses against the two spring contacts mounted on the door frame. The sliding movement helps to keep the contacts clean.

The same arrangement can be readily adapted to the box-frame window, though it may be necessary to modify the scheme slightly for different types of frame. The ideal arrangement is always one where there is sliding contact.

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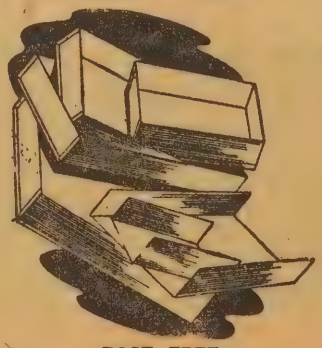

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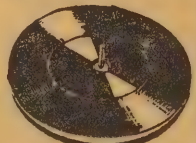

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to pick such a combination. An advantage of the plug and socket idea is that one is always sure that this part of the system is correctly set so long as the plug is in one's pocket. (Handy for the nervous, absent-minded type.)

A disadvantage is that the plug must be placed in the socket before the system can be set up, and this arrangement is not quite so convenient. This, together with the bother of carrying the plug, means that the switch arrangement is generally to be preferred.

As intimated earlier, the whole success of these systems depends on their ability to make plenty of noise; enough noise to convince a burglar that someone is bound to hear the racket and investigate. For this reason, a really good bell is essential, and the inexpensive types normally used as door bells are quite useless. For one thing, the noise they make is quite inadequate in the open air, and for another, they are completely unprotected from the weather.

PROPER BELL

What is required is a large bell specially designed for work of this kind and having a gong about 10in in diameter. It should be of the weather-clad variety, properly designed to stand up to all kinds of weather. Such bells are normally available from electrical supply houses or from firms associated with commercial burglar alarm installations. Unfortunately, they are not cheap, usually costing several pounds, but when the cost of goods lost through theft is considered, they are still a worthwhile investment.

These bells are available in a variety of voltages, ranging from 6 to 240. The 6-volt types are generally used for domestic installations, and these consume about five watts when operated at the normal voltage. However, there appears to be considerable margin of safety on these ratings, and it is significant that many professionally-installed systems increase the voltage to nine for a six-volt bell. This provides a worthwhile increase in volume.

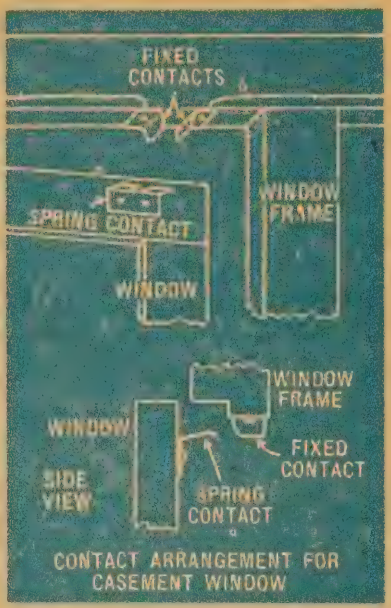
BELL LOCATION

An outdoor spot for the bell must be found which will allow it to be clearly heard, but also where it is not easily seen or reached. A position over a front porch is a good one and it is worthwhile making some checks to find a position where it will be heard best. Usually it will be found that a spot which hides it from view also tends to muffle the sound, so that the final choice may need to be something of a compromise. Painting the bell the same color as its background will help considerably.

The exception to the above remarks is the case already mentioned, where it is required to protect a remote, unattended building. For this, a small bell, or even a buzzer, will be adequate, so long as someone is available to monitor the system.

Discussion of operating voltage naturally brings us to a consideration of the types of batteries which can be used. Operation from the mains is not recommended for two reasons. One is the possibility that the burglar may assume this is so and turn off the main switch, which is normally readily accessible. (This has been known to happen.) The other objection is that a power interruption will cause the relay to drop out, and, since it cannot pick up again, the bell will ring as soon as the power is restored.

Commercial systems prefer dry batteries for the very obvious reason that, apart from the need to renew them at regular intervals, they require no maintenance. A typical battery would be composed of six large cells, such as the Eveready No. 6, giving a total of nine volts. Used in a typical closed circuit system, where the current drain



Although the casement window requires a somewhat modified design the idea of the self-cleaning contacts is retained. As with the box-frame window, it may be necessary to modify the design to suit a particular style.

through the relay is the lowest possible consistent with safety, and on the assumption that it is used every night and for several hours a week during the day, such a set of batteries should last from nine to 12 months.

It is important to realise that such batteries would be capable of operating the relay long after they had dropped below the point where they would drive the bell satisfactorily, so that it is essential to check the voltage, under suitable load, at reasonable intervals. Where a nine-volt battery is used, the end of life voltage is not quite so critical as when the bare six volts is used.

ACCUMULATORS

In an effort to reduce operating costs, many amateurs prefer to use an accumulator. Providing that it is realised that somewhat more supervision is required, and this is no objection, there is no reason why such a system should not be perfectly satisfactory. However, it is hardly as satisfactory for the non-technical user as the dry batteries.

The best arrangement is undoubtedly one where a small charger is used to charge the battery continually at a low rate, the actual value being adjusted to offset the normal drain from the battery, plus the battery's own internal losses. In many cases the latter will be the greater of the two.

Some experiment will be necessary to determine what this rate should be, but a good guide is to maintain each cell at not less than 2.2 volts. If a battery is in good condition, it will not be necessary to provide a very high charge rate to maintain this voltage and something between 100 and 200 mA should be sufficient for even a large battery (such as a 100-amp hour variety). Small types will require proportionately less.

CHECK THE GRAVITY

The final test is to take gravity readings at regular intervals, say every week, until it is obvious that the battery is holding at full charge. After this, the checking may be less frequent but should not be abandoned completely.

A large capacity is not required, since even a small accumulator will operate the bell for several hours, and more than this should not be necessary. If six volts is sufficient, a motor-cycle battery would be about the best size but, if a higher voltage is required, the battery will have to be made from individual two-volt cells. The nearest approach to the nine volts provided by the dry cells would be eight volts from four two-volt cells. The next voltage step, 10, would probably be pushing the overload idea a little too far.

A typical small cell suitable for work of this kind is the type DTG, made by the Exide company, or similar sizes available in other brands. These have a nominal 20 amp hour capacity and, although this is reduced somewhat when the current drain is increased, they should still be able to drive a bell for about five hours. This is assuming an eight volt battery driving a six volt bell. Internal losses are very low and only a few milliamps charge rate would be required to offset them.

THE RELAY

And now a few words about the relay. One of the PMG type is ideal for the purpose and it only remains to decide what coil resistance, contact arrangement, and type of contact is required.

The contact arrangement may be judged from the circuit and is sometimes referred to as a "changeover" contact set. In this the centre leaf carries contacts on each side, making contact with one or other of another pair of contacts, depending on whether the relay is energised or not. In some cases the same effect is obtained by using two spring sets, one normally closed and the other normally open.

The "normally open" contacts will be the holding contacts and the "normally closed" the bell contacts. The bell contacts will be called upon to handle just over one amp of current in most cases and this is rather high for the small silver or platinum contacts normally fitted. More suitable are the heavy duty silver con-

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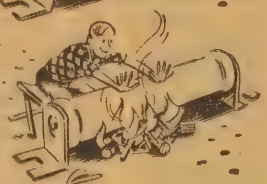

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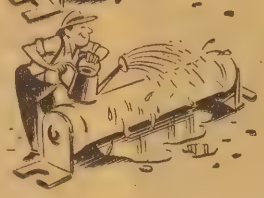

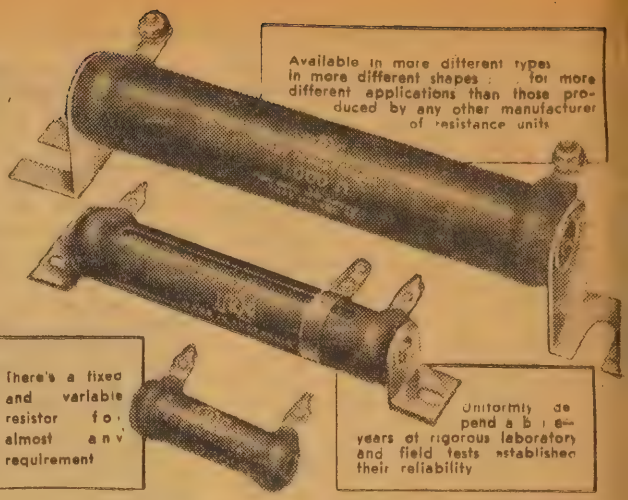

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The hardest job which the contacts have to perform in an inductive circuit, as this is, is breaking the circuit. As it is used here, it should never be called upon to do this, as the bell would be turned off at the main switch. The job of closing the circuit is far less exacting and should not cause any distress to such contacts.

Although the holding contacts do not need to be heavy duty types they will probably be the same as the bell contacts in most relays. As mentioned earlier, they have only the job of holding the circuit closed after the relay is set up and should give no trouble.

COIL RESISTANCE

The coil resistance must be chosen so that there is sufficient power to operate the contacts positively but, at the same time, so that there is not an unnecessary drain on the battery, particularly when dry batteries are used.

On this basis it would appear that 500 ohms would be about optimum for six volt operation and 1000 ohms for nine volt operation. Where an eight volt accumulator is used, the 500 ohm coil would be preferable, since the current drain is no longer critical.

The next point is that of the contacts to be fitted to the windows and doors. These must be absolutely reliable if the system is not to be prone to false alarms and it is false economy to skimp this part of the installation.

It is possible to purchase ready-made contacts from burglar alarm companies and from some radio and electrical supply stores. While most of these are satisfactory, a few designs leave much to be desired and they should be carefully checked and examined before purchase. Another point to watch is that many are only designed for use with open circuit systems and are, of course, useless with closed circuit systems.

An excellent type of switch is the commercial micro-switch which, although not specifically designed for the job, is ideally suited for it. Since it is normally designed to work at much higher current ratings than those in a burglar alarm system, it should have a high order of reliability. Main objection is the cost, though this may not be serious unless there are a large number of entry points to protect.

EXTRA CONTACTS

A further advantage is that these switches usually contain two sets of contacts, one normally open and the other normally closed. Thus they are equally suited to both the open circuit or closed circuit systems. A number of versions are available and the best type for this work is that in which the pressure is applied to the actuating pin through a short spring leaf. This makes the positioning of them, relative to the door or window, less critical.

The present retail price is in the order of 16/-.

At the same time there is no reason why the amateur should not make his own contacts providing he observes certain fundamental requirements. One of these is to avoid the use of contact material which will corrode or tarnish. This is particularly so where there may be an odd window or door which is seldom, if ever, opened. These are most likely to give trouble because they do not benefit from any self cleaning action which may be designed into the contacts.

An excellent material is nickel silver, since it does not readily tarnish and has sufficient spring to retain its shape almost indefinitely. Spring brass is suitable where the contacts are used sufficiently to ensure that they are kept clean but plated spring brass is better, as is plated phosphor bronze and other spring metals.

Where a window or door is never used trouble may be avoided by bridging the contacts with a piece of fine fuse wire, soldered in place, and so arranged that any movement of the contacts will break it.

To overcome the effects of corrosion and dirt it is essential that contacts be made to "wipe" as they close and open (rather than simply press together) so that they will be self cleaning. Some idea of how this can be done is shown in the accompanying sketches which cover most normal requirements such as doors, casement windows, and box frame windows.

Where large areas have to be protected, such as plate glass windows, it is usual to employ trip wires. These are spaced a few inches apart behind the glass in such a way that it would be impossible for an intruder to gain entry without disturbing them. By making them part of the contact circuit they cannot be cut, or stretched to the point of breaking, without operating the alarm.

SPECIAL CLIPS

A variation of the scheme is to fit one end of each wire with clips which grip a metal contact and hold the wire taut. As soon as any pressure is placed on the wire the clip will be pulled off the contact, thus opening the circuit. To prevent all the wire tension being placed on the clip a small coiled spring may be arranged to take most of the weight and being capable of being stretched sufficiently to allow the clip to be pulled off the contact.

The wiring of the system is worthy of some comment. Since the contact circuit is not carrying a large amount of current it may be wired with relatively light gauge wire, making possible an easier installation and a neater job. Plastic covered bell wire is ideal for this and is much superior to the old cotton covered variety. It is available in various colors, including white, and it should usually be

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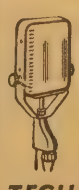

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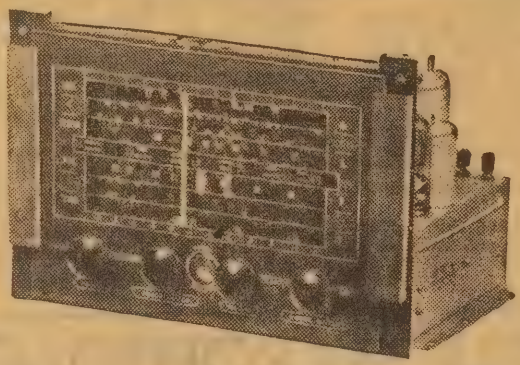

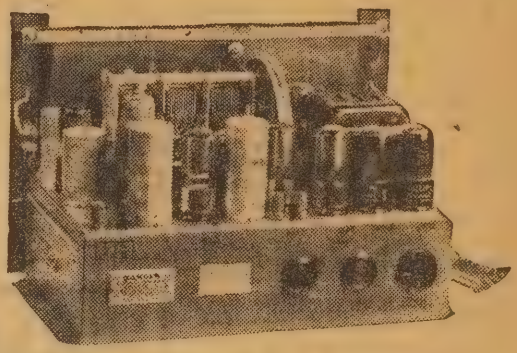

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possible to select a color which matches the interior color schemes sufficiently close to render the wiring unobtrusive.

In the writer's own installation, the wire runs from a window or door contact, straight up the wall to the picture rail, along the rail to a point under the ventilator, up again to the ventilator, then through the ventilator to the outside of the house. From here it is passed over the ends of the rafters, just behind the guttering, to a point near the ventilator for the adjoining room, through which it enters and finds its way to the next set of contacts by way of the picture rail.

NO GREAT OBJECTION

In this way a single wire is taken right around the building, connecting to each set of door and window contacts in turn, eventually returning to the starting point at the switchboard. The fact that the wire is taken outside the building is not a serious objection because it is not normally within reach even assuming that it will be seen and understood, which is unlikely. In any case there is very little a would-be intruder can do about it.

Although it may seem obvious, the point should be stressed that all connections to contacts &c. should be soldered. If this rule is not followed high resistance joints will eventually give trouble, either by causing false alarms if in the contact circuit or failure of the alarm if in the bell circuit.

In some installations, an attempt is made to simplify the circuit by wiring certain entry points only which will protect a portion of the house. Thus the kitchen and similar rooms need not be protected providing valuables are always kept in those rooms which are protected.

This idea is often used in commercial installations where the cost is usually assessed at so much per point. Where the amateur is concerned it would seem a pity to spoil the project for the sake of a few hours extra labor. This is particularly so when it is remembered that some intruders, particularly juveniles, have a habit of indulging in bouts of vandalism if they fail to find any valuables.

The wiring to the bell needs to be somewhat heavier than that for the contacts, since it has to carry the relatively heavy bell current with a minimum loss. Also, as with the bell itself, it needs to be protected against tampering. 1/.044 or 1/.064 VIR cable as normally used for house wiring is quite suitable, particularly the larger, 1/.064, gauge. It is best run above the ceiling to the point where the bell is mounted.

It will be necessary to make up a small switchboard on which to mount the various components and controls and this may take almost any form the constructor fancies. In the writer's case, a small metal box happened to be on hand and this is used to house the relay and on which is mounted the switches and outlet points. No matter what form the board takes it is a good idea to protect the relay against dust which may settle between the contacts and cause trouble.

GOOD CONNECTIONS

Connections to the bell and contact circuits can be made at the board by means of substantial screw terminals or some form of plug and socket arrangement. The writer uses two pin flat plugs and sockets normally intended for power circuits (particularly in 32 volt systems). These are quite satisfactory, though it is a good idea to solder the wires into them rather than depend on the set screw connections. The whole installation is best housed in a cupboard or similar spot where it is not easily seen by prying eyes.

A small refinement which is optional but which is quite worth while is the fitting of a small bell or buzzer, with its own switch, which may be used to check that the relay has really pulled in. This is useful on occasions when the operator may miss hearing the relay come in, and allows the circuit to be checked without turning on the main alarm.

Finally, having installed the system, make sure good use is made of it. Set it up every time the house is vacated, even if you only intend visiting the next door neighbor for a few minutes. It should also be set up at night, because an experienced pilferer can enter and ransack a house without disturbing even a light sleeper.

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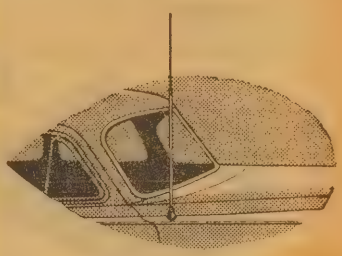

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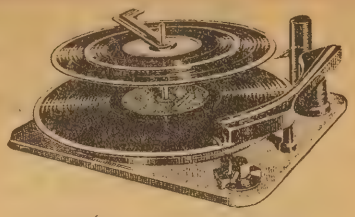

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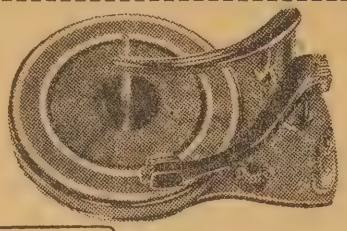

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FROM THE SERVICEMAN WHO TELLS

The owner's version of a set's troubles is normally quite valuable to a serviceman, but it can be misleading. On the other hand the owner who forgets certain vital symptoms is not very helpful either. Each of the following stories serves to emphasise these points.

ONE set I serviced recently is an excellent example of how the customer's story can mislead, his description having all the earmarks of a cranky intermittent but which turned out instead, to be a perfectly straightforward, honest-to-goodness short circuit.

The set was a five valve, dual-wave mantel model of not-so-recent vintage and the owner complained that the volume varied up and down in a most annoying manner and that he had to be constantly adjusting the volume control. I immediately conjured up visions of tracking down an intermittent by-pass (or similar component) with a signal tracer.

However, as soon as I had the set running on the bench I realised that the fault was of quite a different nature, though the owner's complaint was quite legitimate. The primary cause of the trouble appeared to be a noisy volume control which would vary its characteristics at the slightest provocation. So touchy was it that even the vibration from the speaker would cause it to crackle and vary the volume.

As I say, this was the primary cause, but I soon realised that there was more to it than simply a faulty volume control, though a replacement would doubtless have effected a partial cure.

The real trouble appeared to be caused by very high gain in the front end of the set, which was delivering such a colossal audio signal to the volume control that it could only be advanced a very few degrees before the volume was excessive. This made the setting of the volume control extremely critical and was just as much a cause of the erratic volume as the defect in the pot itself.

NO AVC?

A check across the tuning range showed that the stronger local stations were blasting badly and were very distorted, suggesting that the AVC system was not operating. This was quickly confirmed by connecting the voltmeter across the IF amplifier cathode bias resistor, where there should have been a considerable variation in voltage. In point of fact, it was quite steady.

Well at least that was a lead, but the problem now was the essentially practical one of trying to trace the AVC line. The set used a long resistor strip mounted against the back of the chassis and on which were mounted most of the resistors and condensers for the entire set. Some were mounted on the front of the strip and others, including those of the AVC line, at the back.

Not wishing to half wreck the set on a wild goose chase, I decided to check first those parts of the AVC system which I could reach easily. Time enough for a major operation when I drew a blank elsewhere. The most obvious point was the earthy end of the 1st IF secondary and I checked this to the chassis with the ohmmeter. This showed a dead short and I realised that I was on the right track.

To establish in which direction it lay I disconnected both AVC leads from the IF terminal and measured each in turn. The one from the diode network behind the panel appeared to be clear while the one running to the front end of the set showed the short still in existence. Well, that was something, anyway, and at least I would be spared the job of removing the resistor strip.

The next check point was where the AVC line connected to the earthy end of the two aerial coils; broadcast and short-wave. First I disconnected the broadcast coil but the short remained so I removed the short-wave coil. This cleared the short from the AVC line, but it was still in evidence from the earthy end of the coil to chassis.

OUT OF CIRCUIT

The grid end of the coil went to a lug on the wave change switch which, at the moment, was connected to nothing, the switch being in the broadcast position. The only other component in this part of the circuit was the short-wave aerial trimmer, connected between the grid end of the short-wave coil and chassis, and this proved to be the culprit.

And so it was that a short circuited trimmer, in a portion of the set apparently switched out of circuit, served to aggravate a slightly noisy volume control to the point where it was virtually useless. With the short removed the set behaved in a much more normal manner; stations remained at a reasonable volume, the distortion vanished, the volume control setting moved up several degrees and the touchiness disappeared.

Part of the reason for the improved performance of the volume control was the fact that the moving arm was now operating on a new portion of the element and it is probable that it would have continued to function satisfactorily for some time. However, just to be on the safe side, I decided to replace it.

This together with a new trimmer across the coil repaired the main fault of which the customer complained but there were several other obvious defects.

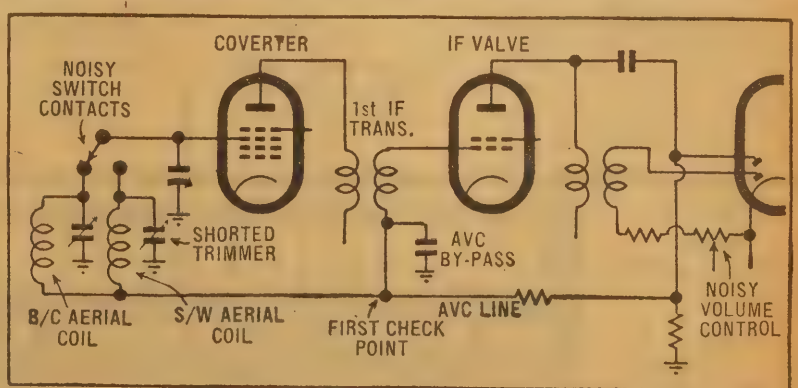
OTHER TROUBLES

One of these was a noisy wave-change switch and it presented something of a problem. A complete replacement would have been more costly than was justified but the owner expressed a desire to retain the short-wave feature if possible. This ruled out any suggestion that the broadcast coils could be wired in permanently and I finally settled for a general clean up of the contacts with a carbon tetrachloride mixture.

This cured the noise for the time at least, though I warned the owner that I could not guarantee the job.

Another feature of the set was that it was fitted with a relatively modern permag speaker, certainly much younger than the set, and it was fairly obvious that this was a recent change. Whoever had fitted it had adopted a very simple method of replacing the field coil. In place of a choke and resistor combination designed to make up the required resistance and inductance they had simply fitted a 2000 ohm 20 watt resistor.

Strangely enough, it worked. The main reason why the hum was not excessive was almost certainly due to the poor baffling which the particular cabinet style provided and I'm afraid I can't recommend it as a regular procedure or condemn the more conservative types who insist



A shorted trimmer, at first glance switched out of circuit, caused failure of the AVC system in this set. The increased audio signal caused the volume control setting to be critical and apparently intermittent. Several other faults were also corrected.

THE

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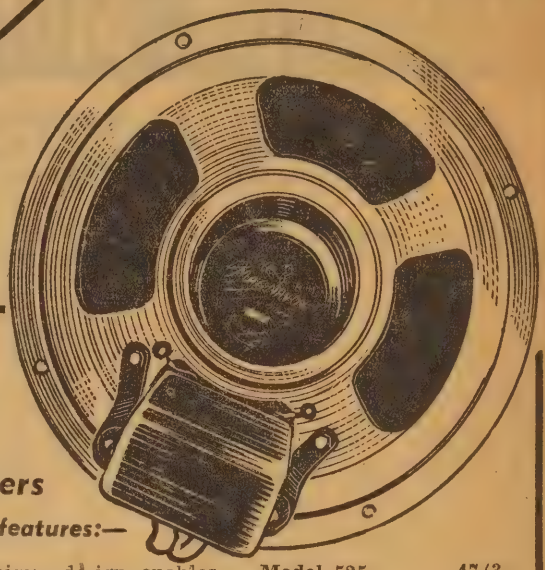

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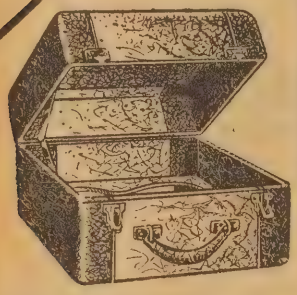

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on some inductance in their filter circuit.

As far as this set was concerned I simply left things as they were, mainly because the owner was not convinced that there was anything to gain by changing it.

Finally, I changed two 25 mfd electrolytics which were bulging at the ends, replaced the power cord (the rubber was coming away in lumps), and checked the alignment. The result was a vast improvement on the set which the owner had brought to me a few hours before.

Another problem which I encountered recently concerned a large music-while-you-work installation in a local factory. The system consisted of a high powered amplifier operated from a record changer which was apparently loaded with a stack of records at regular intervals during the day and allowed to churn out pop numbers until it turned itself off when the stack was finished.

"FUZZY" NOISES

The complaint was lack of volume and "a kind of fuzzy sound" as the operator (essentially non-technical) informed me. A few seconds listening confirmed that he was not exaggerating, particularly regarding the "fuzzy" sound, the distortion being plain woeful.

My first impression was that the pickup armature was frozen against one of the pole pieces, but on checking the needle movement with the finger it seemed free enough. This seemed to throw suspicion on the amplifier and I checked this as best I could in the circumstances, but finally decided that it would be best to take the amplifier and pickup back to the shop.

With the equipment set up on the bench, I checked things over and over again and came to the conclusion that the amplifier was above reproach, thus raising doubts once more about the pickup. More careful tests established beyond doubt that this was the offender, but the puzzling point was just why it was faulty.

As far as I could tell the armature was central and the magnet quite strong, leaving very little else that could go wrong.

However, there obviously was something wrong, so there was nothing for it but to pull the thing down and find out why. With the cover removed, I commenced a more detailed examination and soon discovered the trouble.

ARMATURE CONSTRUCTION

The armature was supported at the top, being fastened to a flat plate of spring steel or similar material. This provided most of the damping, the only rubber used being a thin sheet through which the bottom of the armature protruded. It was much more in the nature of a dust seal than anything else, but it did provide a measure of damping.

Originally the armature had been securely fastened to the metal plate, but now it was hanging like a loose tooth, and this was obviously the cause of the distortion. I had been deceived at my early tests because the rubber seal was sufficient to centre the armature when it was free from the weight of the arm, though it was now clear that it was pushed over to one side whenever it was lowered onto the record.

The next thing was to effect a repair. The armature, which was really a short length of very fine tubing, appeared to have been riveted to the damping plate and I did not fancy the job of trying to repair it. Accordingly, I set out to find the agents for the particular changer in the hope that they could supply a spare armature assembly.

After much telephoning I eventually contacted the firm who imported the units, only to be told, "Very sorry, afraid we can't help you. Import restrictions and all that, you know. Maybe in a few months' time," and so on.

I went back to the bench and had another look at the armature. Was it really riveted or was that a tiny blob of solder on the plate? I examined it more closely, scraped it gently with the point of the knife, and decided that it was solder. That being so, I reasoned that there should be a reasonable chance of repairing the thing with the aid of a hot soldering iron and an unlimited amount of patience.

Since there was nothing to lose (except perhaps my reason), I decided to give it a go.

First I carefully removed the armature from the plate (it was only hanging by a whisker of metal) and then proceeded to clean both parts in preparation for the final soldering effort.

CAREFUL CLEANING

Very gentle scraping with the blade of a knife, followed by some very fine emery cloth, seemed to have best results with the armature and when this was to my liking I turned to the plate. This was treated in a like manner and when it was ready I prepared for the really hard part, the soldering of the two parts together in such a way as to keep all the angles correct and without permanently damaging either part.

I mounted the plate in the vice between two pieces of wood and held the armature in a pair of pliers, endeavoring to keep everything straight while I soldered the two together. Everything seemed to go all right until I took the job out of the vice and examined it, realising when I did so that it was several degrees out of square.

I tried again, managing to correct the first error almost completely, but introducing another at 90 degrees. And so it went on, a process of trial and error until I eventually decided that I had achieved the desired result. Imagine my feelings when I went to assemble the thing and discovered that I had rotated the armature through 90 degrees from its previous position.

Since there was a "V" shaped groove in the front of the armature in which the needle was normally forced by the rotation of the record, and this was now at the side, it was clear that I should have to start all over again.

Fortunately it wasn't as bad as I expected. The experience gained in the first battle with the thing stood me in good stead and I managed to mount it satisfactorily at about the second attempt. From this point on it was relatively plain sailing, simply involving the reassembly of the pickup. When this was completed and tested it functioned perfectly.

Up until this point I had hardly stopped to consider why the pickup had failed as it had, more or less assuming that it was a weak point in this particular design. However, during the process of fitting the equipment back into its factory installation, I obtained additional information which threw some light on the subject.

The operator (non-technical) casually informed me that the record changer was in the habit of dropping records, for no apparent reason, in the middle of the playing cycle, the unwanted record landing with considerable force on top of the pickup. Naturally, no self-respecting pickup could stand up to that kind of abuse indefinitely, and something would be bound to fail. In this case it was the armature-damping plate assembly.

CHANGER TROUBLES

Checking over the changer revealed nothing at fault, as far as I could see, and I turned my attention to the records. These told a rather different story, many of them being badly worn in the centre hole and, since this was where the dropping mechanism operated, was clearly the cause of the premature dropping habit. I accordingly advised the operator that all such records should be either discarded, played only as the first record in any stack, or "hand played" without the changer mechanism.

Now I don't want to "buy an argument" about the desirability or otherwise of record changers (after all, there is a place provided for such argument), but the fact remains that a great many changers are mechanical monstrosities which leave much to be desired in their handling of records.

DROPPING DEVICE

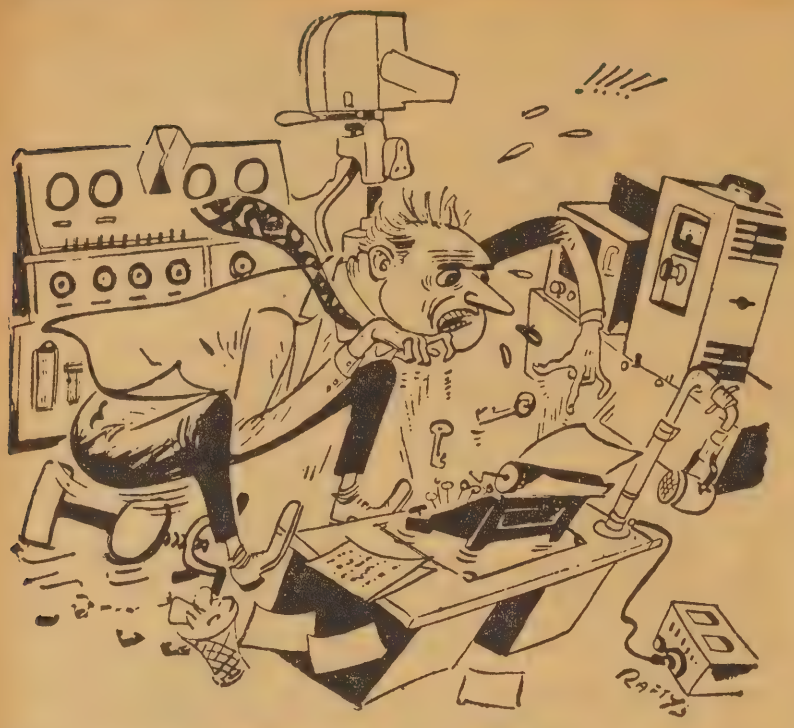
In this case, the weak point was the central dropping mechanism, the record being held by only a very small pawl in the centre spindle. The continual movement of this pawl must cause it to wear while the stationary spindle must eventually wear the hole in the record until it is too large to allow the pawl to hold it positively. When this happens, the record is likely to drop at the slightest movement of the pawl; with the unfortunate results already described.

Doubtless there are many other factors to be considered in the design of a record changer, not the least being the economic one, but it would seem, from the above experience, that the type of dropping mechanism which operates on the edges of the records would have some advantage over the centre dropping type, at least for rather onerous factory work.

Of course, it may be a lot easier to criticise than to design the things and have them mass-produced cheaply by the thousand. Still, there it is.

Various methods of changing records have been tried from time to time, including those which hold a stack of records by the edges and drop them as required, those which do ditto but hold them by the centre, and those which simply pitch the unwanted record over the side of the turntable into a tray. (Horrors!)

There is hardly need to comment on the last method, while the edge holding system appears to suffer from the disadvantage of making the mechanism unduly complicated and unsuitable for playing mixed records.



Let's Buy An Argument

There are various questions in life to which, I understand, the answer is "a lemon". In less colloquial language it means that the answer is unsatisfactory or inconclusive. Working on this basis, the most "lemon-like" subject currently under discussion in technical circles is surely that of reactivating dry batteries.

by W. N. Williams

THE very top letter in the basket of queries at the moment is one from a reader in Forrestville, South Australia. He enters a plea "for some advice on reactivating dry cell batteries" and then says "If you don't have this information, could you please advise where I can get it?"

It happens to be only one of the many enquiries we've had lately on the same subject. Set owners have heard that batteries can be reactivated (or something). They've also heard the story denied and they're just itching to hear from somebody who has done enough research really to know the score.

FACTS & FORMULAS

There's a world of difference, of course, between the observations of someone who has successfully reactivated a few batteries and someone else who can produce facts and formulas to explain what goes on and why things don't always work out according to plan.

Actually, for as long as I can remember, there's been vague talk of rejuvenating run-down batteries by one means or another.

I remember suggestions about stripping whole batteries down and discarding the weakest cells. This was a favorite pastime in depression days, when the man of the house often had nothing better to do, in between spells of roadwork.

The more intrepid souls were encouraged to replace the corroded zinc altogether on the assumption that the chemicals inside the cell would still have useful activity.

Then I remember a scheme that apparently (and conveniently) worked on the opposite assumption. You bought somebody's patent powder, mixed it up and soaked each individual cell for a specified period, after having first punched a hole through the can.

Duly dried, sealed and reassembled, the cells were then supposed to give enough extra life to compensate for your trouble and the cost of the chemicals.

As far as I can gather, most of these schemes went out of fashion with the arrival of better times, AC mains and vibrator supplies.

More recently, however, with so many teenagers carting around portables — not to mention the parents — the subject has come up again with a vengeance. Hence all the queries about it.

How can I save money? How can I get something for nothing?

VARIED REACTIONS

In trade circles mention of the subject is likely to promote anything from a gleeful rubbing of the hands to a state of near apoplexy. It all depends on allegiances and whether the person concerned works in the sales department or the laboratory.

Our first, shall we say, "major" introduction to the current phase was in the form of a letter from the representatives of an English concern, which had developed "an entirely new and revolutionary unit" which tests had shown to "extend the life of dry batteries 6-8 times normal".

We very politely agreed that that was really something but reserved judgment on the matter.

Our attitude might well have been reckoned over-cautious, because the said letter contained a copy of test reports from the National Physical Laboratory. You may have seen mention of them elsewhere.

The "reactivator" was described as a small metal box which was plugged into the mains and designed for connection to a popular combination A and B battery giving outputs of 69 and 1.5 volts. Here I quote from the report:

For the purpose of the tests, six batteries were purchased by the laboratory from a battery manufacturer. They were kept in a room temperature of 20 degrees Centigrade and were discharged through constant resistances of 10,000 ohms and 6 ohms for the HT and LT outputs respectively, under the following conditions:-

(Continued on Page 59)

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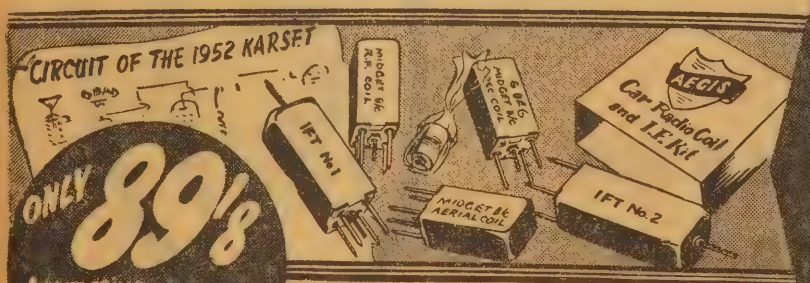

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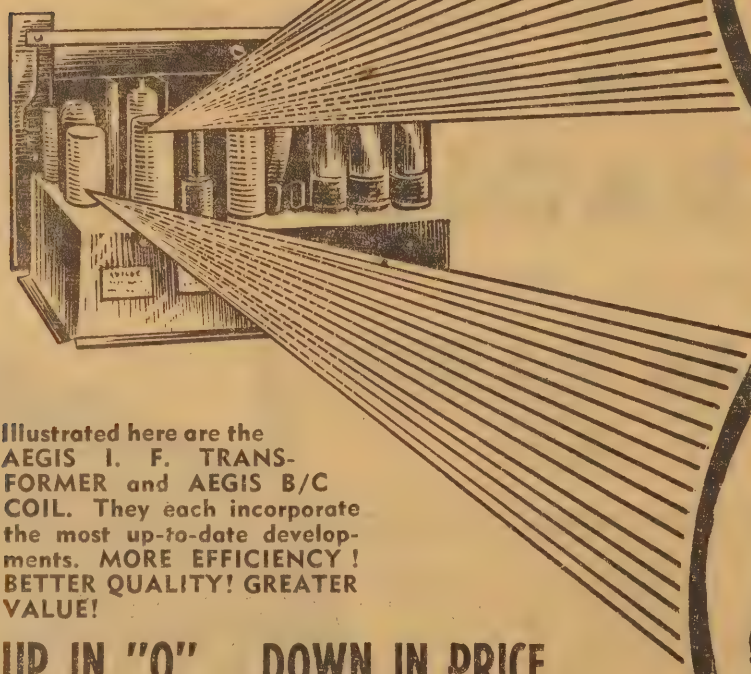

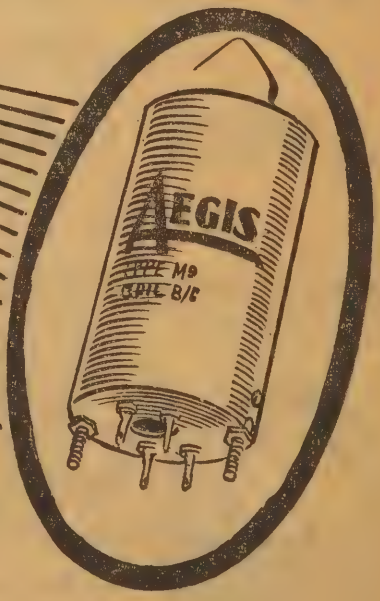

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AEGIS MANUFACTURING CO. PTY. LTD.

★ TURN OVER THE PAGE FOR LIST OF

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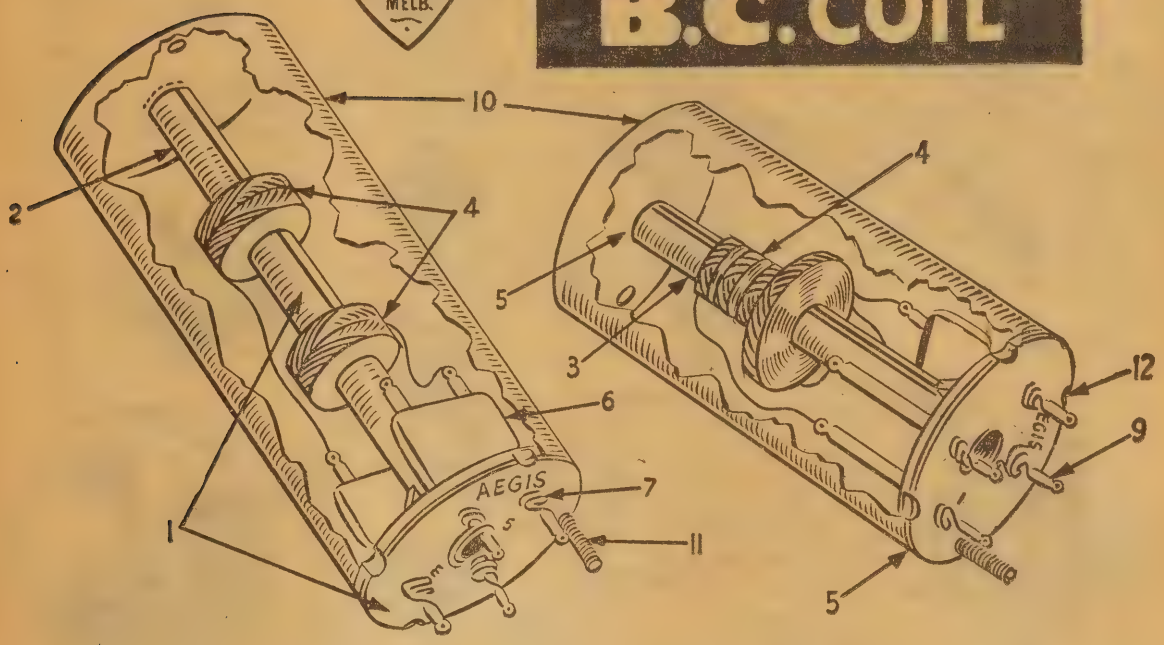

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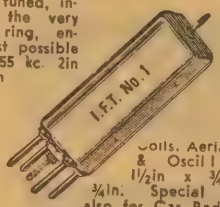

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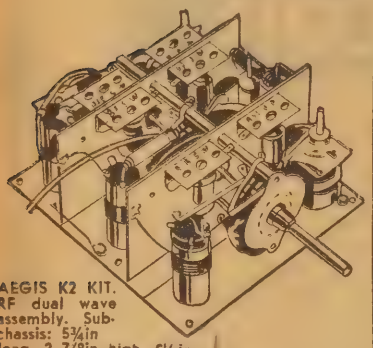
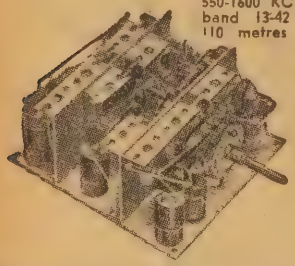
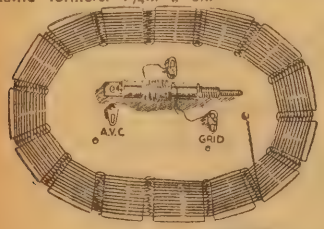


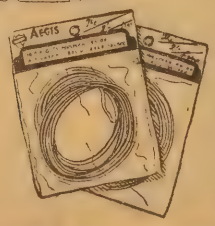
AEGIS K2 KIT. RF dual wave assembly. Subchassis: 5¾in long, 2 7/8in high, 5½in wide. All coils permeability tuned

AEGIS K3 KIT. Covers BC band . . 550-1600 KC & SW band 13-42 & 40-110 metres



AEGIS M17A LOOP AERIAL on oval canvas bakelite formers. 7¼in x 5in





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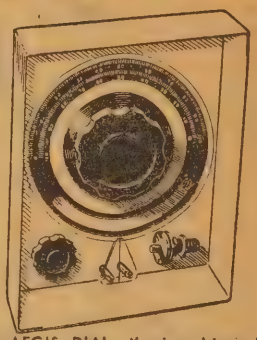
MV3 Tuning Knob. 1 1/8in dia. Black, Walnut, Cream.

MV7 Heavy Duty Pointer. With brass insert. With or without coloured button

MV8 Pointer. Black, Cream, Red, Green.

MV2 Pointer. 1¼in long. ¼in bore. Black, Cream, Red, Green.

MV4 Similar to MV5 only ¼in diam. ¼in bore. Black, Walnut, Ivory, Grey Blue, Green, Red



R5 AEGIS DIAL. Vernier driven 5in heavy brass plate. Calibrated silver on black, 0-100; 100-0. Suitable modulated oscillator, &c

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Dial Drum — bakelite 3in dia.

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Three of the batteries taken at random were discharged for two periods of two hours each day, separated by an interval of two hours during which they were on open circuit, for five days per week, to an end point of 0.9 volt on the LT output or 30 volts on the HT output, measured on load.

The other three batteries were also discharged for two periods of two hours each day for five days per week, but each battery was connected to a "reactivator unit" for two hours between the two daily discharges. The "reactivator units" were connected to a 50 cycles per second 230 volt alternating current supply. The power consumption of a unit when connected to a battery was approximately 3 watts.

The results were as follow:-

The three batteries that were not connected to the "reactivator units" reached the end-point of 0.9 volts on the LT output on the 9th test day and their life was therefore deemed to be 36 hours, including the full discharge period of the day during which the end-point was passed. The HT voltages of the three batteries measured on load at the end of the 9th test day were 36, 35 and 34 volts.

The LT voltages of the three batteries that were connected to the "reactivator units", measured on load at the end of the 9th test day, were 1.32, 1.33 and 1.34 volts; the HT voltages being 59.5, 61.5 and 60.5 volts. The test on these three batteries was therefore continued...

One battery reached the end-point of 30 volts on the HT output on the 66th day and its life was therefore deemed to be 264 hours. The LT output of the battery measured on load at the end of the 66th test day was 1.07 volts.

A second battery reached the end-point of 30 volts on the HT output on the 80th test day and its life was therefore deemed to be 320 hours. The LT output of the battery measured on load at the end of the 80th test day was 1.05 volts.

"CAN'T DO IT!"

Even a sceptic would agree that that makes pretty impressive reading, but, for all that, there were a few at the time who were quite prepared to condemn the idea as plain "hooey". How could you "charge" a primary cell (for that's all it amounted to) let alone achieve a six-fold increase in useful life? This, notwithstanding laboratory reports! It seems that the passage of time has closed the breach somewhat between the varying points of view, and one can keep pretty well in the clear by suggesting that reactivation does lengthen battery life — provided you go about it the right way.

Trying to define "the right way" is where the going gets tough.

Although it sounds simple enough to talk about "reversing the action" or "assisting the depolariser", I am assured by those who should know that the chemistry of reactivisation is really very complex. Having neither the time nor the inclination at the moment to delve into the subject I can but take their word for it.

"Reactivation", in the present use of the word, boils down simply to a charging procedure, exactly as for secondary cells. The battery to be reactivated is connected across a power supply delivering a slightly higher potential than the terminal voltage of the battery.

Just how much charging current flows, depends on the battery itself, on the impedance of the supply, and the presence or otherwise of a series "ballast" resistance in the charging circuit.

Some early attempts at reactivation by this means met with indifferent success. The batteries got hot, swelled noticeably, and thereafter ceased to function. That "charging" got a bad name was not surprising.

The explanation appeared simply to be that the charging circuits delivered more reverse current than the batteries could take — the result of insufficient "ballast" resistance, excessive mains voltage, battery variations and other like factors.

It became obvious that dry cells were no more tolerant of excessive reverse current than they were of excessive load current. Either way, there was likely to be internal heating and distortion, loss of moisture and, therefore, an early end to a merry life.

REDUCED CHARGE

It was very obvious too that reactivating circuits, to be at all safe, had to have sufficient internal resistance (or ballast effect), to keep the charging current at all times within the normal discharge rate of the cells in question. (Current practice is to limit the charge rate to nearer 25 pc of the discharge rate.)

Things like that aren't too difficult to control in a special reactivating unit, but the circuitry is likely to get a bit tricky when the batteries have to be charged "in situ" in a regular AC/battery portable. And it becomes all the more tricky if the sales people insist that you must be able to reactivate while-you-listen or while-you-don't, in any situation, without special knobs and adjustments.

There is always the danger of overcharging on the one hand or, through over-caution, actually discharging the batteries when you're supposed to be activating them!

As far as equipment is concerned, it boils down to three possible approaches:

HOW MUCH CHARGE?

(1) A special reactivator unit for use with specified batteries — technically an excellent scheme. Its weakness lies in the need for educating non-technical people in it's regular and proper use, plus the obvious nuisance of having to handle the batteries so much.

(2) An "activate" circuit in a standard AC/battery portable, arranged to function when the set is not in use. This is technically sound, more convenient than a separate unit, but likewise prone to excessive or insufficient use.

(3) An AC/battery portable with provision to activate while you listen. It saves the owner forgetting the batteries altogether, but the designer has to assume a ratio of mains/battery operation and to design within the narrow limits imposed by a supply well enough regulated to run the receiver, but with enough "ballast" effect to maintain automatically a safe charging rate.

Whichever way you approach it, the same question lingers: Will the batteries be charged too little, too

RESULT OF REACTIVATION TEST

The curves, copied from a National Physical Laboratory's report, indicate that reactivation is well proven in principle. The burning question is whether an average set user will realise anything like as much benefit from relatively haphazard periods of charge and discharge.

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much, too fast, too soon or too late? The whole success of the idea depends on the answer and that's the point of the matter.

It's one thing for white-coated technicians with meters and watches and time switches, to run a carefully controlled series of tests. It's quite another for a set owner to achieve anything like the same results, switching on an unknown unit just when he thinks of it.

The technicians may get their six or eight times increase in life, or even more, but the casual set user can hardly expect the same results. As I've already indicated, when things go really wrong, he may get no benefit at all or even hasten his batteries to their doom.

But the story isn't finished yet. Investigations indicate that a charging procedure, applied to a primary cell, makes it behave something like a secondary cell. The terminal voltage gradually rises with continued charging till it gets up over the 2.0 volt mark.

Can you imagine what happens to delicate 1.4 volt valves with 2.0 volts on the filament and as much as 120 volts on the plates and screens? Yes, that's right!

In other words, you can't safely anticipate a weekend's heavy listening by giving the batteries a good, solid charge beforehand. There's the ever-present risk of finishing up with an excessive terminal voltage and no valves to use it on!

The optimum routine appears to be something like this. A new set of batteries is installed and operated as required for the first few hours. This makes some inroads on the resources of the cell and slightly lowers the terminal voltage.

The battery is then put on charge, to which it begins to react like a bank of secondary cells. The terminal voltage rises in consequence and it must be assumed that it is not allowed to build up to an excessive figure.

TWOFOLD FUNCTION

When next used, the battery gives up the charge it has previously received and with it a further small measure of its normal potential as a primary source of power.

So the process continues until the chemicals are exhausted, or the electrolyte has dried out, or both.

In other words, the periodic charge and its partial "secondary cell" effect, is used to supplement the normal output of the battery as a primary source of electrical energy. The effective life is therefore increased.

It follows that the full benefits of reactivation can only be realised by exploiting this supplementary effect to the full, by properly regulated and alternate periods of discharge and charge.

It is also equally obvious that no great benefit will ensue from forgetting a battery for most of its useful life, then suddenly trying to boost it with charging when on the point of failure. Such a cell will simply not have the chemical resource or the moisture content to accept a charge.

Rather like trying to feed green oats to a dead horse!

And that, I feel, just about winds up what I set out originally to say. It's not a learned discussion but it does at least indicate that the whole subject of reactivating batteries is complicated by many "ifs" and "buts".

ELECTRICAL WIRING IN THE U.S.

Dear Sir,

I see in the September issue of Radio and Hobbies that you are worried about the grey hairs being grown by the American electrical power authorities over their seemingly ill-chosen mains voltage of 110 volts.

Being an American who has spent most of his life in America, chasing various electrical and electronic faults, I feel obliged to clear up this puzzling situation for you and put your mind at ease.

In the first place, the voltage supplied at the meter board of an American home is not 110 volts but 220 volts, with a centre tapped earth. The light and power points are thus divided in halves between two "legs". These 110 volt power points (which incidentally are never fitted with switches, the switches being rightly placed on the appliances) take care of the usual run of small appliances (toasters, sewing machines, washing machines, radios, etc).

For any heavy electrical equipment such as stoves, or heavy motors, special 3-pin outlets or junction boxes are installed, and special wires taken back to the meter board to get 220 volts with a centre tapped earth. One distinct advantage with the 2-pin power points is that it is utterly impossible for even a "Dagwood" to put a new plug on a power cord in such a way that the "toaster" frame becomes electrified. I understand that quite a few Australians have done just that by putting the "green" wire on the wrong pin.

The biggest reason why the American power authorities aren't getting worried however, is that the power isn't taken around the cities as 110 volts, but rather as 2200 volts, down every street, and past every house either in overhead wires or underground.

In sparsely settled areas, every house is supplied with a transformer with a KVA rating sufficient for its needs. In congested areas, it is split up to one transformer for every two or three houses or apartments.

The result is that instead of enormously heavy copper cables being bravely supported by what must be the strongest light poles in the world, a tightly strung line of ¼in conductor with a steel core gaily supplies electrical loads that amount to about three times the per capita loads of Sydney not counting the industrial load at all.

The industrial power, by the way, is sold to the consumer as either 2200 or 4400 volts, 3 phase. It is the consumer's job then to step it down and distribute it as his electricians see fit, which usually amounts to a 110 volt lighting supply, a 440 volt machinery supply and an 880 volt heavy machinery supply. As an incentive to efficiency, the consumer gets a reduced rate for a high power factor and balanced load.

I can truthfully say that in all the low voltage troubles I have struck in the States, the trouble has been with either bad household wiring or a supply transformer too small for the needs of the home. In the latter case, a call to the "light" company, and a demonstration, brings a bigger transformer right away and at no cost. In the former case, the trouble has usually been due to the fact that it was an ancient house wired with 16 B & S gauge wire in the days when electricity was only used to "light the lights".

I have run into a few of these houses in Sydney, too, (I'm living in one of them now), where there is only one power point in the place, a dilapidated looking affair added as an afterthought in some practically inaccessible spot in the kitchen.

On the subject of transformerless receivers (I hate them, too), I would like to point out that there are literally millions of them in use in America being sold at bargain prices. (12.95 is a good figure), five valve mantel sets. The only reason there aren't hundreds of Americans electrocuted every day is the exhaustive tests an organisation known as the Insurance Underwriters Labs. puts these models through before they go into production.

Having worked in the test lab. of an American factory I am familiar with these tests. Electrolytics in the set are deliberately blown up with AC (shorted rectifier) to see if they will set fire to a piece of cotton wool wrapped around them. Potentiometers are given a breakdown test between shaft and lugs of 1000 volts and even pilot light sockets are completely insulated. The reason for this is that the chassis is not tied to one side of the AC, but is merely bypassed to it with a 0.1 meg resistor and a .01 condenser, all the negative wires being "carried" rather than "earthed" to the chassis (a trap for servicemen who occasionally get hold of an American AC-DC).

All this works out very well as far as safety goes, but the trouble comes when an attempt to align them in the normal manner is made. A signal generator clipped to the chassis introduces an atrocious carrier modulation hum and possibly even instability. The only satisfactory way of coupling into them is by way of an inductive loop. If you look at your "American mags." more closely, you will see what I mean by a floating chassis.

Yours faithfully, J. W. W.

It does indicate, too, why proclaimed results vary all the way from a six-fold improvement to nothing at all. That caution in charging is safer than excessive zeal.

And John Citizen? I tip that he'll get double life from the batteries, perhaps a trifle more, allowing for all the hazards of design and usage.

That assumes, of course, that he can be bothered with it at all.

At this stage I'm not trying either to knock or to boost the idea. It has interesting possibilities, but it obviously has complications as well.

(Continued on page 112)

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RADIO TO FIGHT BUSH FIRES

Damage to life and property from bushfires still remains one of Australia's gravest national risks. Each year brings a tragic incidence of suffering and ravaged countryside. Already this year authorities are alerting country shires to the danger which follows a dry winter and early spring weather.

PERHAPS it isn't out of place to commence an article dealing with bushfire-fighting by reminding you that far too many fires are caused by careless and thoughtless actions, and need never have been started.

It is tragically easy to light a fire in hot bushland or dry grass by a match thrown away, or a cigarette butt discarded. It takes only a few seconds for flames to develop beyond any hope of quick suppression.

CARE WITH FIRES

Of course, these are not the only ways in which avoidable fires can begin. It would be impossible to list every point of danger. But we can all help by making sure that no action of ours could ever be blamed for such a catastrophe.

It is little comfort to the men who risk their lives in quenching a fire to know that someone didn't really mean to start it. It's too late to be sorry when homes are blackened heaps, crops razed to dry earth, sheep and cattle condemned to agonising death.

For these are the inevitable results of bushfires, even those close to home. Standing between the flames and the damage they can do are thousands of fighters, volunteer and otherwise, who, year by year are called upon for sacrifice and effort.

For fire-fighting is essentially a community business. When the alarm goes out, all must stand by to play their part if called upon. Fires are the more dangerous because they are capricious. Seasons may go by with no danger or threat of danger. Districts are lulled to security in the belief that it couldn't happen here.

And then one day it does happen, and once more human nature is tragically wise after the event. Eternal vigilance may not bring security from bushfires, but it does ensure that those threatened have some chance instead of none.

The primary responsibility for fighting bushfires is in the hands of the various shire councils, which are assisted by bodies and individuals within the shire. Behind them again are various government committees and authorities which supply a degree of co-ordination, facilities for obtaining and using specialised fire-fighting equipment, and much valuable background work and research.

SPEED VITAL

The problem of firefighting varies very greatly from shire to shire, and is largely dictated by geographical conditions. Some shires are obviously less menaced by fires than are others, and the fire risk will be different according to the state of settlement and the damage which can be done to areas prone to fires.

For these reasons, organisation must be flexible as well as adequate, and often calls for considerable resource from those in charge of operations and planning. Virtually every shire has its voluntary brigades. The speed with which these can come into action and proceed with their work is a vital factor in bringing any outbreak under control.

As with any operation of this type, communication is most important. Ideally there should be a quick method of alerting the fighters in case of an alarm, assembling them at the point of danger, informing headquarters of requirements and progress, and instructing those at the fire what to do and where to do it.

USES OF RADIO

A good deal of this communication can be had by using local broadcasting stations and telephone lines, which today are well distributed throughout the country.

From this point, however, more flexible methods are generally required, and in many cases are absolutely necessary. Telephone lines are most vulnerable in bushfires, which by cutting a few vital points can remove communications from areas where they are most useful.

An obvious means of communication, therefore, is radio. It can

supplement existing methods, and maintain contacts when no others are available. It can save time when time is most valuable. It can be moved from place to place to pass messages from action posts.

Radio for bushfire work has been used by some shires for a considerable time, but the field is by no means completely covered.

There are several reasons for this. Many councils are not yet aware of what radio can do for them—others do not understand either its possibilities or its limitations sufficiently to spend money on equipment. Suitable radio gear is expensive, and because it is generally used only in an emergency, represents an investment which lies idle for long periods.

MAKING YOUR OWN

The purpose of this article is to survey the problem in general terms so that those interested can apply them to local conditions, and perhaps find an answer which is lacking at the moment. It will deal with general radio organisation for bushfire radio, and suggest what equipment is required and how it may be obtained.

In future articles we intend to describe actual transmitters and receivers for operation on bushfire frequencies, so that in cases where local radio amateurs or servicemen are available to help out with time and labor, they will have some guidance.

Many of our readers have already written asking for such constructional details, so that they may build their own equipment and place it at the disposal of shires when emergencies arise. Already there are public-spirited citizens who have done just this, making the necessary installations in their own vehicles.

This equipment will also be suitable for other users, such as the owners of small ships who are encouraged to carry emergency radio transmitters for operation on allotted frequencies.

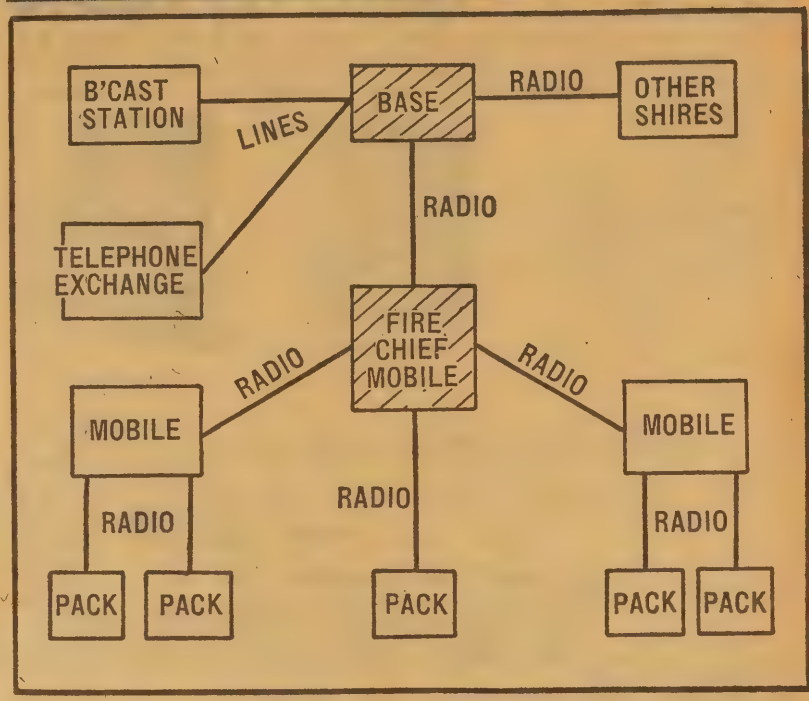
WHAT TO EXPECT

Probably the first question to be answered when considering the use of radio is "What can it do?" To which we suggest the addition of an equally pertinent query, "What can't it do?", as many still consider radio to be a magic box with supernormal powers. Where once it was "all done with mirrors", today it is too often "all done by radio".

First of all, under favorable conditions, radio equipment can be made to be suitable for the frequency or wavelength set aside for any given shire, and operated with little more demand on skill than required by a telephone or the tuning of an ordinary radio set. In fact the only time tuning may be needed is when the length of the aerial is changed, and then this can be eliminated. At a base station, or in a utility truck, this adjustment can be made once, and then virtually forgotten. Mistuning will in any case merely reduce the efficiency of the equipment.

Because crystals can be used to lock both transmitter and receiver to their correct frequency, there need be no danger of missing out on calls through adjustment to the wrong station or frequency.

BLOCK DIAGRAM OF RADIO NET



This diagram shows how a complete radio network may be built up. Some such plan should be aimed at, even though all facilities shown are not available at first.

Normal operation can be simplified to turning a switch or pressing a button to change from receive to transmit and setting a volume control. One or two other adjustments could be fitted to improve results, but these are not vital to the passage of messages.

Communication equipment operated on this basis is used every day all over Australia by police, ambulance, metropolitan fire brigades, and even newspapers! It is virtually a mobile telephone which doesn't need wires.

Unfortunately the radio communication set hasn't yet been made which will be 100 pc effective at any distance over any type of country at any time of the night or day. In other words, there is no system which will be perfectly reliable throughout the entire area of a big shire.

VHF AND HF

Because most mobile radio systems are required for use over fairly short distances, such as a metropolitan area, Very High Frequencies, abbreviated as VHF, are used. These give strong signals with quite low power as long as the two points have no great obstructions between them, such as mountains or hills. With "visual range", 100 miles or more can be covered, as from hill-top to hill-top.

But bushfires are just as likely to break out in rugged country, where there are plenty of hills to restrict range to a few miles, or it may be impossible to site a base station except in a hollow. Therefore, not all shires could satisfactorily use such equipment, which in any case is very costly.

By far the largest amount of general communication over various distances is carried out on the High Frequencies, abbreviated to HF.

In general terms, these are the frequencies included in the short wave section of many home receivers.

For bushfire work, the PMG Department, which issues licences, will make available frequencies between 2 and 8 Mc, according to their availability and the needs of other services.

"SKIP" RECEPTION

These frequencies have the ability to skip over most hills and rough country, and the equipment they require can be made extremely simple and therefore less expensive than that for VHF.

Unfortunately their disadvantage is that this "skipping" effect, which becomes appreciable a few miles from the transmitter concerned, is by no means consistent, but varies greatly from daylight to dark and is not the same at 2 Mc as it is at 8 Mc. Static and electrical noises are also rather troublesome when signals are weak, although these can be greatly reduced by using suitable circuits.

However, bearing in mind the type of transmission required, the matter of cost and maintenance, and the availability of frequencies, they have been selected as being the most useful.

Summing up, therefore, it can be said that no radio system is completely reliable under all possible conditions, and its reliability is likely to be variable according to prevailing radio conditions (not necessarily weather conditions). Obviously, however, radio practice during normal times will allow reasonably accurate assessment to be made of what can and cannot be done in communication from areas of bad fire risk. Where range appears

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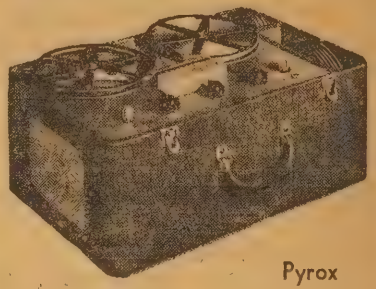

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too short at any given time, relays are quite possible with a mobile transmitter or an amateur transmitter suitably located. People with short-wave sets might also be able to hear messages which are not getting through, and relay them by landline.

Remembering the great value communication will be during fires, the balance is definitely on the side of the equipment which, if effective for only the majority of the required time, is far better than nothing at all.

FIRE RISKS

During much of the time, radio signals can reach very good strength, and ordinary speech is used either with a microphone held in the hand and a loudspeaker at the receiver, or with a telephone headset. Where operators are available, Morse code can be used to communicate when speech is inaudible, but this would not be normal procedure. The main requirement is operation by unskilled people who have been shown how to work the equipment as they would learn to drive a motor car.

In the case of a shire council considering the matter of bushfire risk, the use of radio will naturally depend on whether the council thinks the fire risk is large or small. This is something beyond the scope of this article, which must assume that there is such a risk, and the question is whether to install a radio system and if so how to go about it.

In approaching the problem, the council would do well to ascertain whether any facilities exist within the shire for radio communication and used by other bodies. It may be more economical and satisfactory to consider bushfire facilities as supplementary to a system in everyday use, assuming it can be diverted in an emergency to assist firefighters.

A further advantage of tying in with an existing system is that, being in everyday use, its performance throughout a given area will be known fairly accurately, and a nucleus of men used to handling it will be available. The practicability of the scheme will depend on whether it will be available in emergencies, whether the cost of the additional units will be reasonable and so on. It is virtually impossible to be dogmatic as these considerations will vary greatly from one case to another, and the solution found accordingly.

A COMPLETE NET

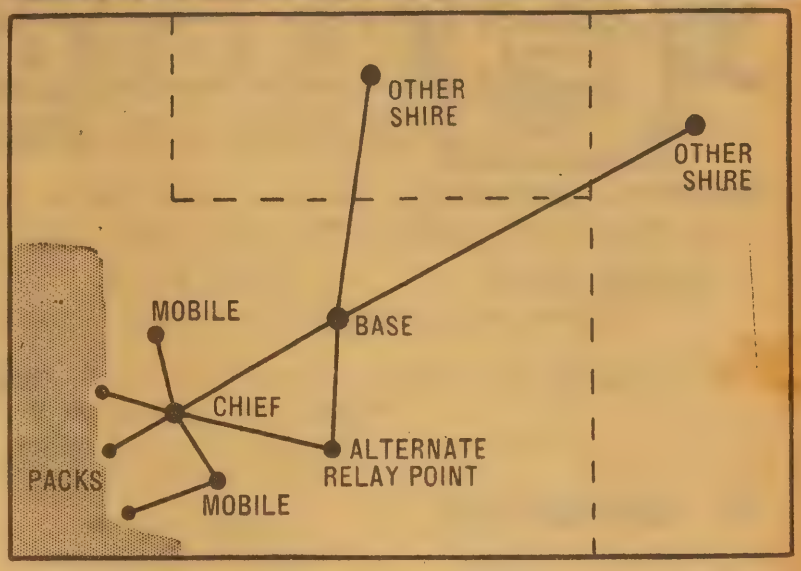
Assuming that it is necessary to start from scratch with no facilities or equipment, the next decisions will concern (a) the method of using the radio net, and (b) the type of equipment which will be used. Let us first discuss point (a) as it will have some bearing on the answers to point (b).

It is probably logical to make a case for a complete network which can be varied or modified to suit local conditions. To do so, we might imagine a big fire at some distance from the main town and shire offices in which a steady stream of instructions, requests for assistance, materials, food, &c., is involved, together with warnings to district residents and general briefing of what is going on.

There will usually be two key men in such an operation—the officer directing fire-fighting, and an administrative officer who will see that all messages are properly routed and requests from the scene of the fire are met.

The first man will invariably be the fire chief at the scene of the fire, and the second at some base, probably in the town. He may be the town clerk, police officer, or some similar person with the necessary authority and experience. It is vital that these men be recognised and given full co-operation from all concerned.

TYPICAL NETWORK FOR FIRES



In the field, radio units might be distributed as shown here. The possible use of amateur stations within the shire as relay points should not be overlooked. Amateurs can be most useful in operating and maintaining the radio net.

NET CONTROL

Experience has shown that unless the authority to issue instructions is recognised and limited to as few key men as possible, the network will become jammed with miscellaneous matter, messages which conflict with each other, unco-ordinated requests, &c., all of which degrade the service and prevent it from operating as it should.

When the fire breaks out there will be general warnings issued, key individuals alerted, and men and equipment to be rushed to the scene. The administrative controller and the fire chief will decide on these. Here a link with the local broadcasting station will be vital, and constant liaison will probably be necessary until danger is past.

After the fire units have departed to the scene of action, the second phase begins in which administration can expect all kinds of demands for aid. So we have established the primary need—an operations base in the town to receive all instructions except those involving fire-fighting itself.

AT THE FIRE

The fire chief will have assembled a number of vehicles—cars, utilities, &c., probably owned by local people attached to the fire-fighting team—and as many of these as possible should be equipped with radio. The fire chief may use his own vehicle to contact his fleet, probably over a few miles only, and also the town, where his administrative colleague is standing by.

All these sets will work on one frequency or wavelength, the chances being that everybody will hear all the messages as they are passed backwards and forwards, acknowledging and acting on those directed to them, and noting the remainder for information.

Order is established and confusion avoided by keeping to simple operating procedure similar to that used in any normal radio network, and previously made clear to all concerned.

So far only one frequency is involved—that allotted to the shire by the PMG. But it may be that the emergency will extend to two shires, both of which will be involved, or the shire immediately concerned may require assistance from its neighbor.

SHIRE TO SHIRE

To accommodate such cases, there is a single frequency allocated by the PMG to be used for inter-shire traffic. As the man who will call for such assistance, or receive appropriate information will be the administrative officer in the town, he must be able to change his transmitter and receiver to this common frequency for the purpose.

Thus his equipment will differ from that in the field in that it has two channels instead of one. Instructions from the fire chief will never go on this inter-shire channel directly, as it must not be jammed with operational messages which the intra-shire frequency is intended to handle.

Telephone facilities in the area will of course be available to supplement the radio, to carry less urgent messages, and even to relay information which cannot otherwise be accommodated. Even direct contact will be used where appropriate. Intelligence and organised handling will weld them all into a tight whole.

The final radio application which will be possible in some cases is the

(Continued on Page 69)

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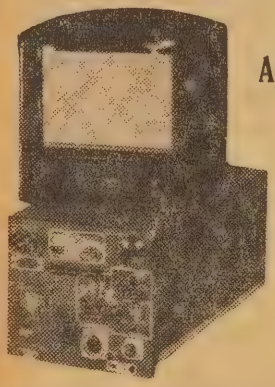

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RADIO TO FIGHT BUSH FIRES

(Continued from Page 65)

use of pack-set receiver-transmitters carried by parties of men on foot. Being battery-operated, these are likely to have a shorter range and be less dependable than the larger units, and would probably have their main value in handling messages between such parties and the fire chief. They can be extremely valuable in this service, saving much time and effort where otherwise messengers would be required with some transport at their command.

Thus the ideal set-up would be a base station in the town capable of communication with other shires and with the fire chief, a number of radio-equipped vehicles under the control of the chief who can also talk back to the base station, and smaller pack-sets carried by fighting parties who would normally clear all their messages through the fire chief. Backing them will be the broadcasting station and/or telephone exchange to handle messages of a general nature for direction to all, or to specific persons.

BASIC PLAN

This structure in principle is the same as that applied to handle any operations on a similar scale, whether they be concerned with fires, floods, or defence.

It is unlikely that a complete set-up such as this will be practicable in every shire, at least in the initial stages, although some shires have already advanced almost to completion. It should be possible however to plan for the installation of a base station and two mobiles for a start, and to adapt the whole plan or portions of it. It is quite important to appreciate the basis of an effective network and to ensure that it is capable of going into action at all times.

It should be mentioned here that nobody can operate a transmitter which is not licenced by the PMG Department. The PMG will grant licences to shire councils on the recommendation of the Bush Fire Committee in NSW, and appropriate authorities elsewhere. All transmitters used for bush fire work must therefore be under the supervision of the shire council. For this reason, independent action on bush fire radio by country people is inadvisable, and may lead to complications, whereas in co-operation with the local shire it will be welcomed.

RADIO SUPERVISION

A further requirement of the PMG is that each system in each shire be under the technical supervision of someone acceptable to the department as being able to see that the equipment is kept in good order and not liable to cause interference to other services.

This supervisor need not necessarily hold high radio qualifications. Most shires can enlist the aid of licenced amateur transmitters living in the country who normally use equipment similar to that required for bush fire work.

These licencees mostly maintain equipment which can easily be operated on bush fire frequencies, and can therefore be taken into the network itself to extend its usefulness. Such amateurs have already built up a fine record of public service particularly in flood relief work, where at times they have provided the only means of emergency communication. A number of strategically located amateurs can supply invaluable relay facilities when, for instance, a mobile transmitter must work from an awkward spot.

Considering now the type of equipment which will be needed, we are in a position to state fairly clearly some major requirements.

(1) Both transmitters and receivers should be as simple as possible to save cost and reduce maintenance.

(2) Controls should be reduced to a minimum, so that equipment will call for virtually no operating skill.

(3) Equipment should be locked to the operating frequency to eliminate the need for tuning. Crystal control is preferred.

(4) The base station should operate on both intra-shire and inter-shire frequencies with rapid change-over facilities to either.

(5) Mobile equipment should be small enough for easy mounting in vehicles, using a power supply operating from car-type batteries and with moderate battery drain. It should be suitable for use with an aerial mounted on the vehicle, as well as a longer wire aerial which can be strung to a near-by tree.

(6) No special components or valves should be needed.

(7) Pack sets should be light enough to be carried by one man, operate from dry batteries, and have sufficient power and duration to maintain operation over short distances for a reasonable period of time.

(8) Ruggedness and reliability are essentials.

SUITABLE GEAR

To satisfy these general requirements, it should be possible to produce a single transmitter-receiver unit on one chassis which can be operated either from an AC power supply of 240 volts or a vibrator unit powered from car batteries. Each type of power supply would be built as separate units of similar size, so that, by suitable combination, one assembly could serve as the base station and the other as a mobile station.

The base station would need to cover both the inter-shire and the intra-shire frequencies, but the mobile stations only the latter.

Both receiver and transmitter would be locked to frequency preferably by a crystal so that no tuning as such would be needed. Some simple aerial adjustment may be needed, but this could be pre-set for given aerials to keep all adjustments to a minimum.

That such an equipment is practicable is illustrated by the low-powered amateur transmitter recently described, which had substantially these facilities. It has been used with marked success on both 3.5 and 7 Mc amateur bands, which lie near the extremes of the frequency band from which shire frequencies will be selected.

Many amateurs already have mobile equipment capable of being used satisfactorily, and with substantially the above-mentioned requirements.

The pack-set, which might be regarded as of lesser importance, should not be a difficult problem in principle, although its limitations of size and weight might call for some constructional care, comparable with that of a large portable type receiver.

Some manufacturers produce equipment which would meet these specifications, although at the moment the selection does not appear to be large. For this reason, ex-disposals sets have been used in the past with reasonable success, but these are now becoming more difficult to obtain and are generally somewhat difficult for an inexperienced operator to handle.

POSSIBLE DESIGNS

Our main interest, however, is to help those of our readers who have asked for something they can build themselves. We in turn have commenced to lay out designs for them which will be acceptable to the PMG and the bush fire authorities.

It is not suggested that these are the only designs which would be suitable, or that results would be substantially different from commercially-made equipment. But unquestionably there will be instances where money can be saved by the use of skilled voluntary labor in building and setting up the equipment, and perhaps maintenance made easier. In many cases the equipment might be donated by local residents to help. Such factors alone might well decide whether a shire can afford to install a radio service or not.

Aerials for the equipment pose their special problems, not so much for the base stations as for the mobile units. Base stations will probably be able to erect resonably high wire aerials, preferably in areas where electrical interference is not great, and these will greatly assist their radio coverage.

Each vehicle must be able to work from an aerial fixed to it, although there will be times when a longer aerial can be used with improved results, even if it is abandoned when the vehicle moves on in a hurry. Packsets are limited to much shorter aerials attached to the case, which is an important factor in limiting their range.

In next month's issue we will carry the story a stage farther, and probably describe the first piece of the equipment. In the meantime, we will welcome any correspondence from our readers who have suggestions or experience to offer.

FUSES ARE IMPORTANT

FUSES are used in many radio receivers, test instruments, audio amplifiers, motor cars and house wiring circuits to protect parts from overheating and damage when short-circuits or overloads occur.

A fuse is, therefore, an intentionally weakened part of an electric circuit.

In many cases the fuse wire is enclosed in a cartridge, which is clipped into the circuit. The method is particularly advantageous in the case of very fine fuses, which are difficult to handle directly, especially as they inevitably have to be replaced in a hurry. For larger fuses, the wire can be clipped directly between the terminals.

If you value your equipment ascertain the correct fuse rating and make sure that a fuse of higher rating is not used as a replacement. If a fuse of the correct rating fails immediately, look for faults.

NEW PORTABLE P.A.

Here is a truly portable P.A. system which can operate anywhere, either from the AC power mains or from the battery in your car. Completely self-contained in one carrying case, it will amplify speech or music separately or simultaneously, to a nominal power of 10 watts. It is ideal for house parties, local dances or public meetings. A follow-on from the PA system described in last month's issue, this complete versatile unit will satisfy many requirements.

THOUGH but a short period has elapsed since last month's issue was placed on sale, the PA system described therein has already produced marked enthusiasm for the idea, old as it is.

That unit functioned on AC mains only. This month we present the complete system arranged for operation from AC mains or battery power, together with full details of the carrying case plus a few remarks on its construction and covering with leatherette.

The actual amplifier and its combination power supply fit into a small wooden rack which slides into the carrying case housing the speaker and cables. When required for use, the two units slide apart, the speaker stragetically placed for best coverage of the area to be served while the small but neat leatherette-covered rack is placed within easy reach for access to the partly-recessed control knobs.

Two microphones or one microphone and a pick-up may be used, each being controlled separately.

For the two-microphone arrangement, one is connected to the pick-up channel, the other to the normal microphone channel. Each channel has a separate volume control. The microphone on the pick-up channel should be of the high output type such as a crystal, or dynamic with associated transformer, and should be used under reasonably close talking conditions if full output from the amplifier is to be realised.

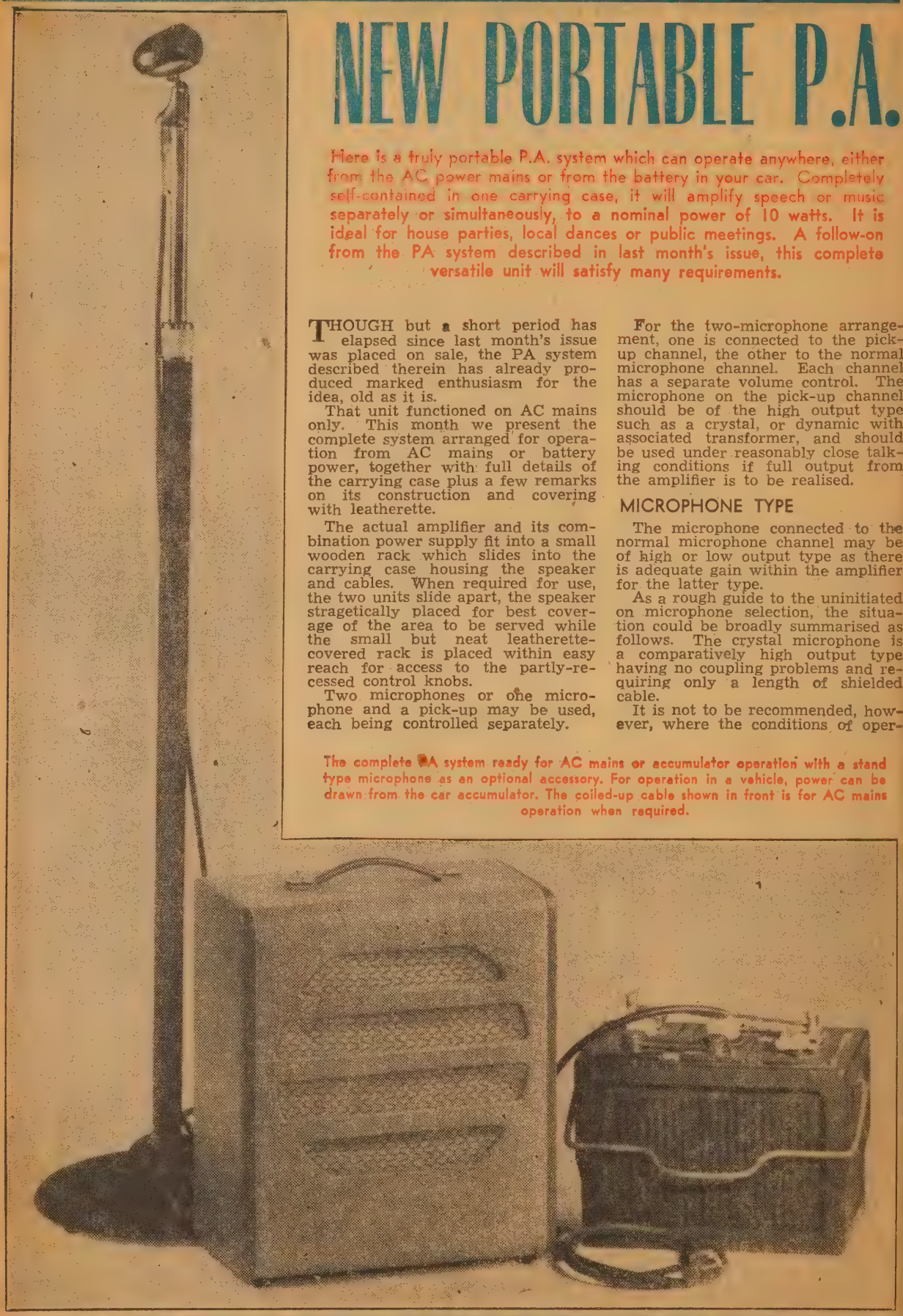
MICROPHONE TYPE

The microphone connected to the normal microphone channel may be of high or low output type as there is adequate gain within the amplifier for the latter type.

As a rough guide to the uninitiated on microphone selection, the situation could be broadly summarised as follows. The crystal microphone is a comparatively high output type having no coupling problems and requiring only a length of shielded cable.

It is not to be recommended, however, where the conditions of oper-

The complete PA system ready for AC mains or accumulator operation with a stand type microphone as an optional accessory. For operation in a vehicle, power can be drawn from the car accumulator. The coiled-up cable shown in front is for AC mains operation when required.



OPERATES ON BATTERY OR A.C.

by Raymond Howe

ation of the PA system subject the crystal microphone to extreme temperatures or high humidity. Such conditions may arise in closed vehicles parked in the sun or in unceiled buildings or huts in hot weather.

If such circumstances are likely, the better choice is the dynamic microphone. Not only is it less susceptible to variable weather conditions but it is quite robust, allowing plenty of latitude in its general handling.

However, the dynamic microphone normally requires a microphone-to-grid coupling transformer which has to be accommodated somewhere. For short microphone cable lengths up to about 30ft, the transformer is usually mounted in the microphone case and connected to the amplifier through shielded cable. For greater lengths, the microphone is connected to the transformer primary winding through unshielded cable and the secondary winding connected to the microphone input channel.

MIC. TRANSFORMER

In some cases, the microphone transformer may be mounted on the amplifier chassis but care must be taken to avoid hum pick-up or coupling with other inductive components. Heavy metal shielding or orientation of the transformer is sufficient cure in many cases, particularly where the power supply is on a separate chassis.

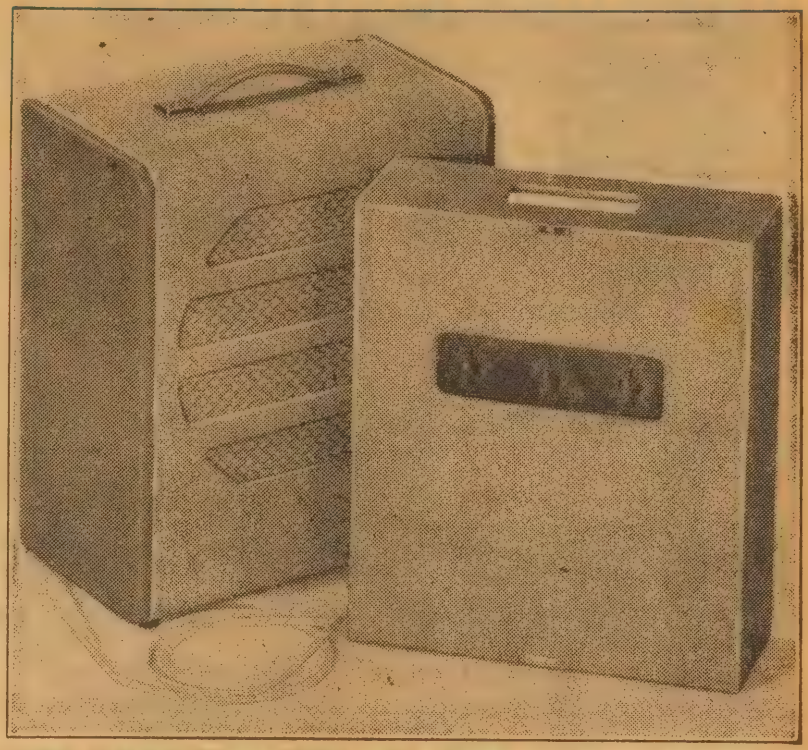
Another solution is to leave the transformer free and to connect it to the amplifier through a yard or so of shielded cable, earthing the cable braid to the chassis.

Where better quality is desired for stage work indoors, the more expensive ribbon type microphone is a good choice. The usual "dead" spots to each side give greater freedom in speaker placement in small halls before encountering acoustic feedback. Close talking with this type of microphone should be avoided due to a tendency to "blast".

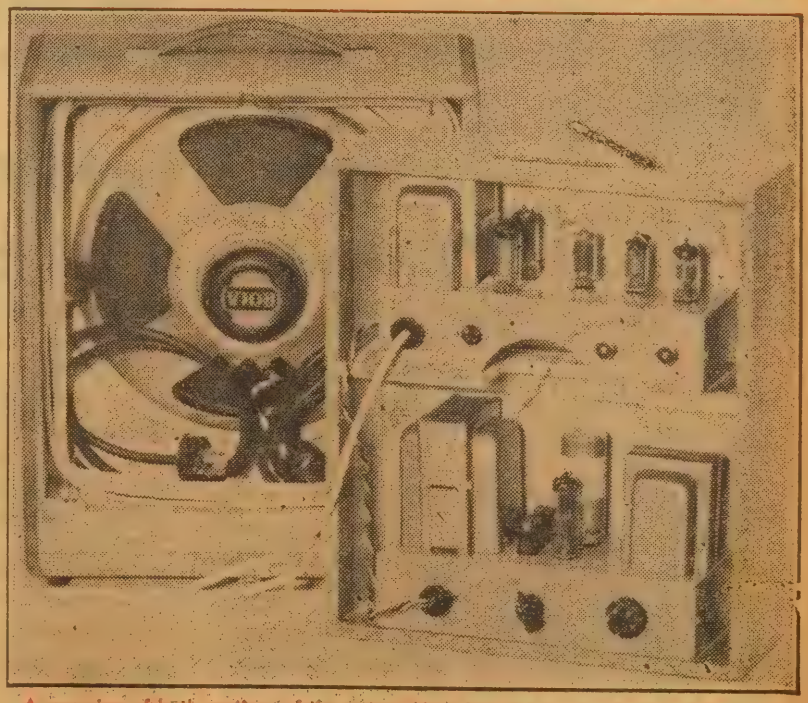
This type will normally require an input coupling transformer and the same remarks apply regarding its arrangement as for the dynamic type.

Getting back to the PA system, a detailed discussion on the amplifier itself was given in last month's issue and consequently in this article we will focus our attention on other aspects of the system.

The amplifier proper remains un-



Here is the amplifier rack removed from the carrying case housing the speaker. The controls are backed by a combined scale plate especially marketed for the unit. Note the hand slot in the top of the rack for moving it about on the job.



A rear view of both portions of the system. Note how the speaker lead and the power input cables are coiled up near the speaker. The input and output and the control switch of the power supply are on the rear face of the chassis.

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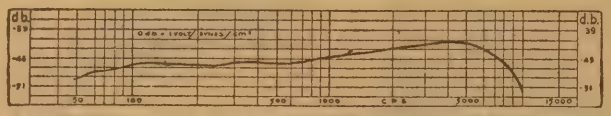

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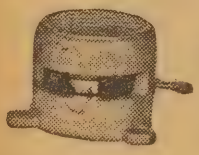

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with all other makes, and you, like leading manufacturers and professionals, will insist on

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Full & Half Track.

Pre-aligned for easy installation, you just screw them to your deck, and the tape is guided by the precision machined slot in the annealed iron case. You may record and play back with separate heads without loss of high frequency response.

★ It's the exclusive "high-low" windings (patent pending) which make possible the higher output (up to eight times that of other makes) and wider frequency range, with lower distortion and noise level. And remember—all heads are GUARANTEED to comply with the published specifications.

Technical Specifications of Head Type HL2T:—
Record-Playback combined: Half Track. (All figures for Tape Speed 7½in per second.)

Low Impedance windings:—5 ohms at 1000 c.p.s. Used principally for bias. Audio may also be applied, if desired. High Impedance windings:—40,000 ohms at 1000 c.p.s. Used for audio. All windings astatically wound.

Output:—Approximately 10mV, with low distortion at 1000 c.p.s (will vary with individual tapes).

Gap Width:— .0003in. Hard rolled copper alloy spacer maintains sharp, clean gap. Gap width unaltered by pole wear. Gap accurately aligned with base, and tape slot.

Frequency Range:— 20 c.p.s to 11,000 c.p.s (with equalisation). All heads tested with a standard tape for response and gap alignment within the following limits:—

Up to 8,000 c.p.s .. .. plus or minus 1db.

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The Case:— Heavy wall section reduces hum pickup by 10db.

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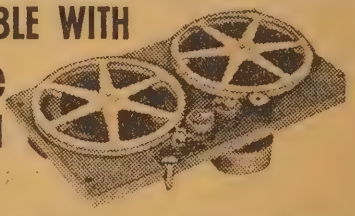

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Heavy balanced flywheel.

One control knob, 7½in per second tape speed.

Fast forward. Rewind 100 seconds.

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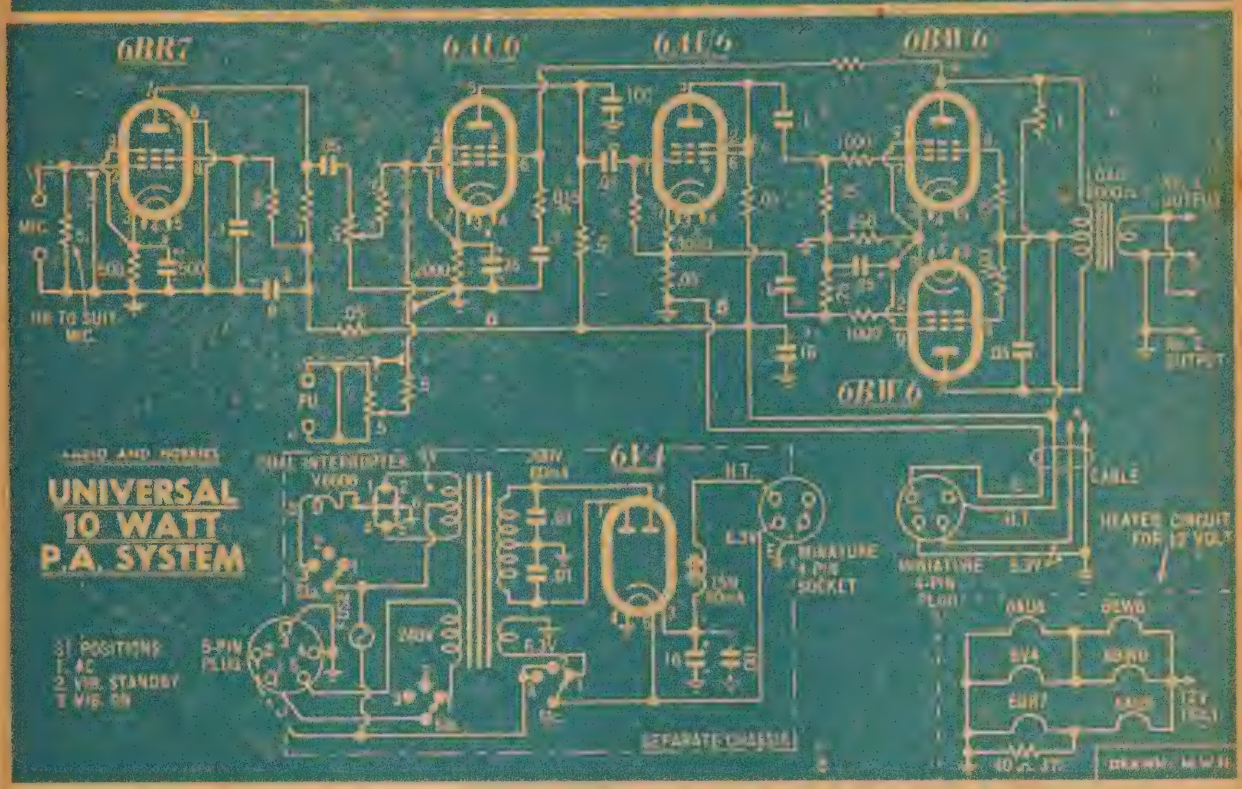
FEATURES TWO INPUT CHANNELS, DUAL POWER SUPPLY



The circuit diagram of the amplifier and dual supply. The unit can be converted for 12 volt operation by using a V6612 interrupter and a dual power transformer having a 12 volt vibrator primary and a 12.6 volt heater winding in lieu of the 6 volt windings shown A suggested rearrangement of the valve heater circuit is shown in the inset on the diagram.

altered with two small exceptions. These are a change in the 6BR7 cathode resistor bypass from 25 mfd to a 500 mfd 12PV electrolytic capacitor and the increase in value of the tone control capacitor between the plates of the output valves from .02 mfd to .05 mfd.

From our observations with the speaker mounted in its cabinet, the extra treble cut provided by the .05 mfd value is to be desired for general use.

The combined vibrator and AC power supply featured in this month's issue is built on the same chassis as that used for the straight AC supply described last month.

DUAL SUPPLY

The difference lies in the power transformer type, the fitment of a 3-pole, 3-position, single gang switch in lieu of the SPST switch and the addition of a dual interrupter cartridge and fuse holder.

The circuitry of this dual supply is essentially the same as that for the 6/240 Amplifier of the February and March, 1949, issues. The power transformer carries two primary windings, one for 240 volt AC input and the other for a 6 volt dual interrupter cartridge. The high voltage secondary is common to both windings for each mode of operation.

For AC operation, the valve heaters are fed from a 6.3 volt heater winding while, for vibrator operation, the valve heaters are switched to the 6 volt DC source.

Fortunately, the switching operation is simple to change the circuit over from one source to another. One section of the 3-pole, 3-position switch controls the 6 volts to the vibrator driving coil another controls the 240 volts AC to the other primary winding and the third controls the excitation to the heater circuit.

The centre position of the switch is a "standby" position for vibrator operation. In this position, the heaters of all valves are alight but the vibrator cartridge does not function until the switch is placed in the "Vib. on" position.

Two input leads are required, one for AC and one for vibrator, each having a 5-pin socket at one end,

PARTS LIST

2 Chassis 9½in x 3¾in x 2½in.
1 Power transformer, 240V AC and 6V centre-tapped vibrator primaries, 300V a side 80mA and 6.3V 2.5A
1 15H 80mA filter choke.
1 6 volt dual interrupter (type V6606).
1 output transformer (15 watt) 10,000 ohms push-pull with tapped secondary ranging from 2 ohms to 15 ohms.
4 9-pin and 2 7-pin miniature sockets 3 4-pin miniature plugs and sockets, 2 5-pin plugs and sockets, 1 6-pin socket.
2 shielded microphone connectors, 1 10 amp. fuse holder.
1 3-pole, 3-position single gang switch. (preferably non-shorting).

VALVES

1 6BR7, 2 6AU6, 2 6BW6, 1 6V4.

CAPACITORS

1 500 mfd 12PV, 2 25 mfd 40PV, 2 16 mfd 525PV and 1 8 mfd 525PV electrolytics, 4 .1 mfd, 2 .05 mfd, 1 .01 mfd (paper tubulars are miniature 350WV or higher), 2 .01 mfd 600WV. 1 100 pf.

RESISTORS

1 5 meg. ½w. 1 1 meg. 1w., 1 1 meg. ½w., 2 .5 meg. potentiometers, 2 .5 meg. 1w., 2 .5 meg. ½w., 2 .25 meg. ½w., 1 .1 meg 1w., 1 .1 meg. potentiometer, 2 .05 meg 1w. 1 .05 meg ½w., 1 .015 meg. ½w., 1 3000 ohm ½w., 1 2000 ohm ½w. 2 1000 ohm ½w., 1 500 ohm ½w., 1 250 ohm 3w. wire wound, 2 100 ohm ½w.

SUNDRIES

4 knobs, 2 5-tag and 2 2-tag mounting strips, 3 ½in i.d. and 3 5/16in i.d. rubber grommets, 1 3-pin mains plug, pair heavy duty battery clips, rubber-covered 3-core power cable, 1 special indicator plate for controls, 1 ft. shielded hook-up wire, spaghetti sleeving, hook-up wire solder, solder lugs, nuts, bolts, materials for carrying case.

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The Acos GP.30 turnover head type pickup is fitted with two separate sapphire styli, one for standard and one for microgroove records, either of which can be placed into operating position by a simple turn of a knob at the front end of the pick-up arm. The knob is clearly marked to show which stylus is ready for use.

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(for GP.20 microgroove) GP.19L.P. -- -- **£2/19/9**

(for GP.30 Turnover) GP.29 **£2/19/9**

(for GP.10 Standard) GP.9 **£1/11/6**

(for HGP Turnover) HGP.33 **£3/17/6**

The HGP.33 crystal cartridge is a high compliance cartridge which is used in the Model HGP.34. The salient points of this cartridge are:— Extremely high compliance and low mass; Completely hermetically sealed crystal unit; Universal mounting.

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with the other end arranged to connect to its appropriate source. Use different methods of connection at the supply end of each cable to avoid damage to the supply if plugged into the wrong source. In other words, a 3-pin plug for the AC mains leads and a pair of battery clips for the DC leads would be a logical method of connection.

Use 3-core rubber-covered cable for both the AC and the accumulator leads. With the AC lead the green-colored core should connect the chassis of the supply (and the amplifier) to the earth system of the mains wiring. With the accumulator, the third wire can be paralleled with another to reduce the DC resistance of the cable.

The wiring of the 5-pin socket on each cable is made to pick up the correct wiring in the power supply when mated with the 5-pin plug on the chassis. The AC mains connect to pins 1 and 5. Polarity of connection to a battery is immaterial, which is a handy feature for use in a car. Pins 3 and 4 are earth returns, pin 2 is the active 6-volt lead.

CABLE LENGTH

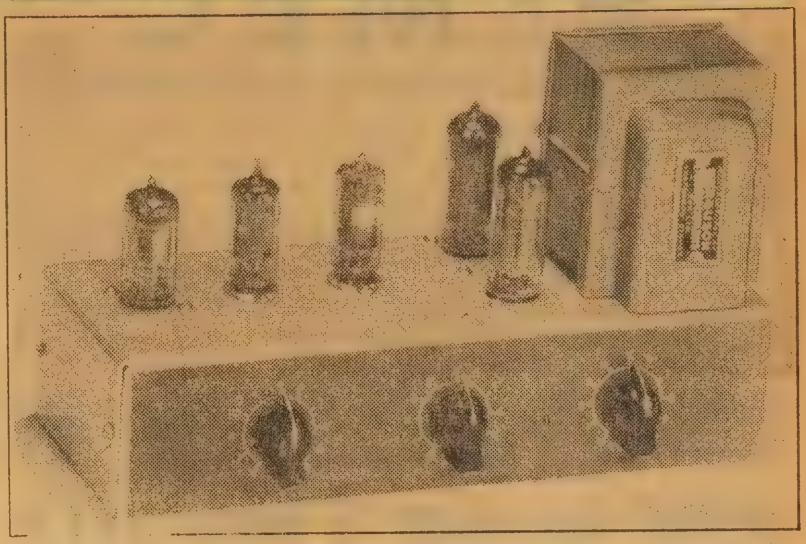
The length of each cable can be selected to suit normal requirements although some instances will arise where it will be necessary to use an extension lead to make connection to the power mains. Keep the accumulator lead length down to a minimum to avoid unnecessary voltage drop between the accumulator and the amplifier.

You will note that we have shown a fuse in the lead to the vibrator primary winding of the transformer. This is a safety measure against accidental overload in the supply or "sticking" of the vibrator contacts.

A 5 ampere fuse may run a little close to its rating. A 10 ampere fuse should give sufficient protection.

Although there is a little more to the wiring of this supply than the straight AC supply described last month, it is still relatively simple. After sorting out the transformer leads and the switch wiring, there isn't much left to be done.

AMPLIFIER AND POWER CHASSIS



In this view of the amplifier chassis the valves from left to right are in the same order as in the circuit diagram. The controls from left to right are:— mic. gain, PU gain and tone.

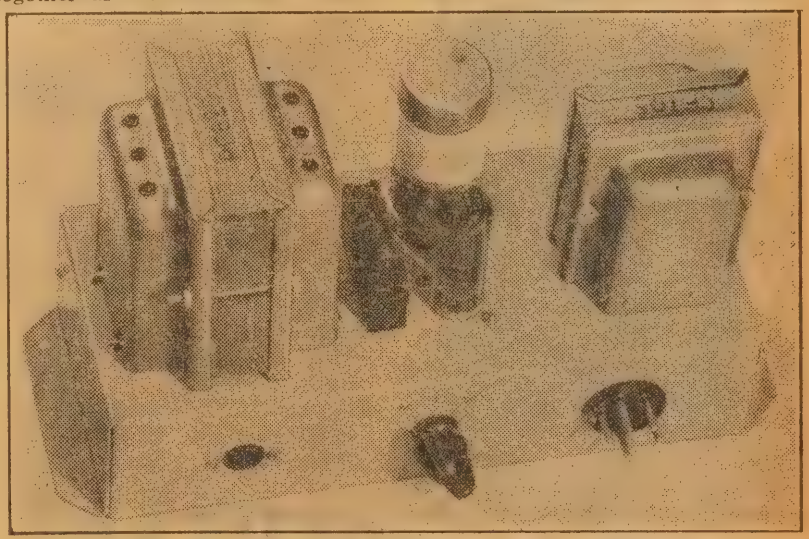
Make sure when you have cut the vibrator primary winding centre-tap lead to the correct length for wiring that the two enamelled wires contained in the one spaghetti sleeving are carefully cleaned and soldered together as the connection is made. The continuity of the winding depends upon this.

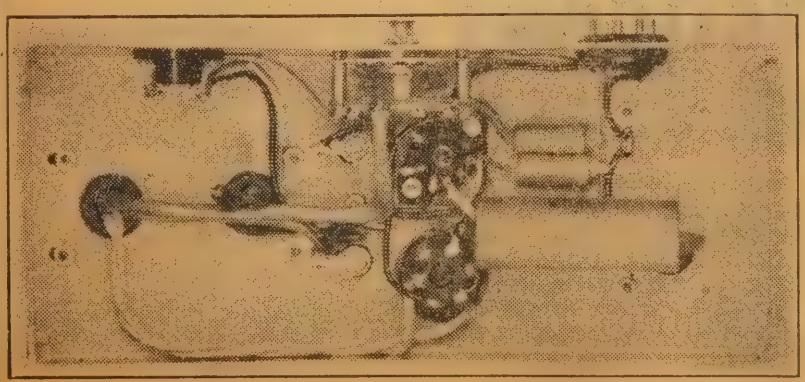
The vibrator socket is mounted directly to the chassis without rubber suspension. There is little need for this in the circumstances.

Note that certain contacts on the vibrator are paralleled. See that the correct pins on the socket are connected together.

Fortunately, vibrator "hash" currents in the chassis do not constitute much of a problem in this type of unit as the amplifier and the power supply are on separate chassis and we are dealing with audio frequencies only. For these reasons no particular care need be taken in arranging a common earth point on the power supply chassis.

It turned out, however, that it was very easy to make all earth connections excepting the 16 mfd electrolytic and the .01 mfd buffer capacitors to a point under one of the transformer mounting bolts near the vibrator socket. The earth lead from pin 6 of the vibrator socket should be made in heavy wire such as the





These two views show the arrangement of the components on both the top and underside of the power supply chassis. The 5-pin input plug is at the right in both views, with the miniature 4-pin output socket to the amplifier at left. Make sure that the wiring to 5-pin socket on each power input cable makes connection only to those pins with which it is associated on the 5-pin plug.

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braid from shielded hook-up wire.

The buffer capacitor value of .01 mfd is the optimum value for the particular transformer which we used. A different brand may well call for a different buffer value. However, the buffer value is usually given in the data supplied with a transformer.

A point to remember is that the buffer value may be given as the total capacitance across the secondary. For example, in the circuit diagram, the two .01 mfd capacitors from each side of the secondary winding to centre-tap are in series across the whole winding and thus effectively represent a value of .005 mfd across the whole winding.

The advantage of placing two capacitors in series across the winding is that an effective working voltage of twice that of one capacitor is obtained. For the 600VW tubulars, this gives a working voltage of 1200, a handy rating where the voltage across the whole winding is already at least 600 without considering possible transient peaks.

If you are using an unknown transformer for which you have no data on buffer value, there are two ways in which you can arrive at the correct value. One is to inspect the transformer secondary voltage with a CR oscilloscope and place various buffer values across the winding until the observed waveform takes on a near-square-wave shape without peaks or "whiskers" at the tops.

Another method is to place an ammeter of suitable range in the lead to the vibrator primary winding centre-tap and select buffer capacitor values which give the lowest primary current when the supply is delivering power to the amplifier.

A STRAIGHTFORWARD AC mains version of this PA system was described in last month's issue commencing on page 52. For a detailed discussion on the amplifier design we would refer our readers to that issue.

The presence of the buffer capacitors at the secondary winding does not markedly affect the operation on AC mains.

With the finished supply connected to the amplifier, plug in the speaker and take it some distance away. Set up for vibrator operation, connect a microphone to the "mic. input", turn up the microphone gain control and listen in the speaker for any sign of vibrator "hash".

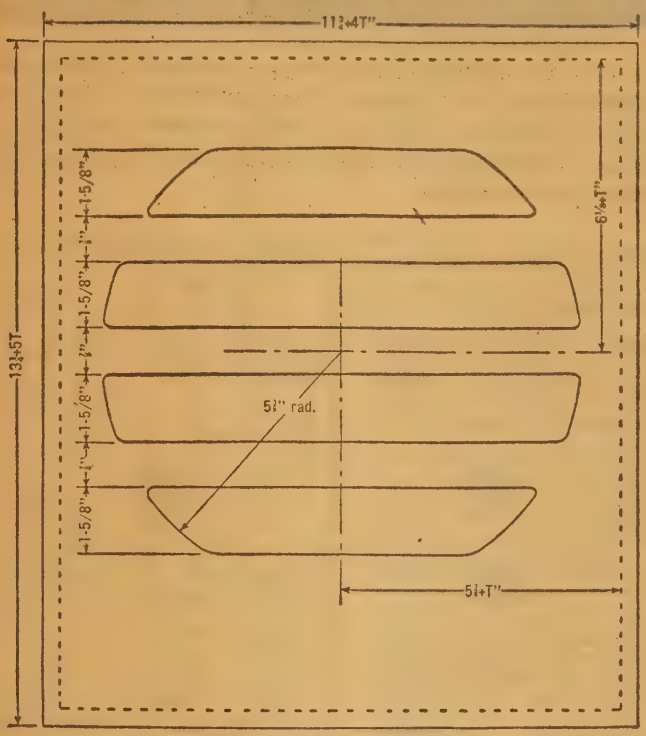
You should not have trouble in this respect, but we have shown a .001 mfd capacitor dotted across the first 16 mfd electrolytic as a possible aid in reducing what mild interference may be present.

A complete carrying case for the PA system will be available on order through most radio houses in Sydney. It is a two-tone leatherette-covered item with contrasting plastic piping and complete with carrying handle, rubber feet, rear clips and covered speaker grille.

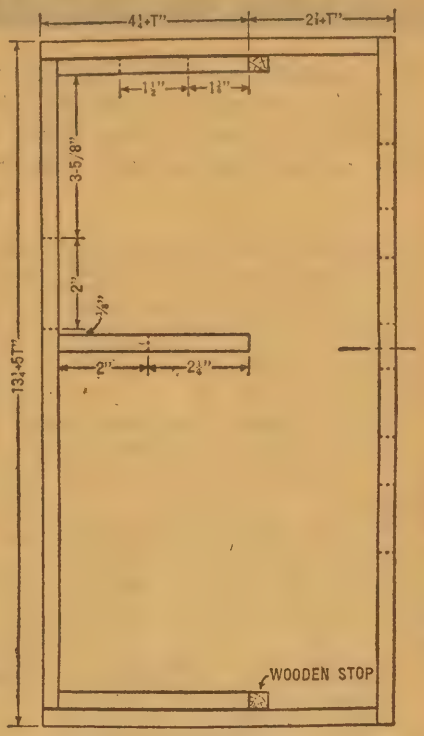
If you wish to make up one on you own account, we are publishing in this issue all details of the cabinet measurements. Most experimenters will be able to produce a reasonable effort with a nominal number of wood tools.

(Continued on Page 101)

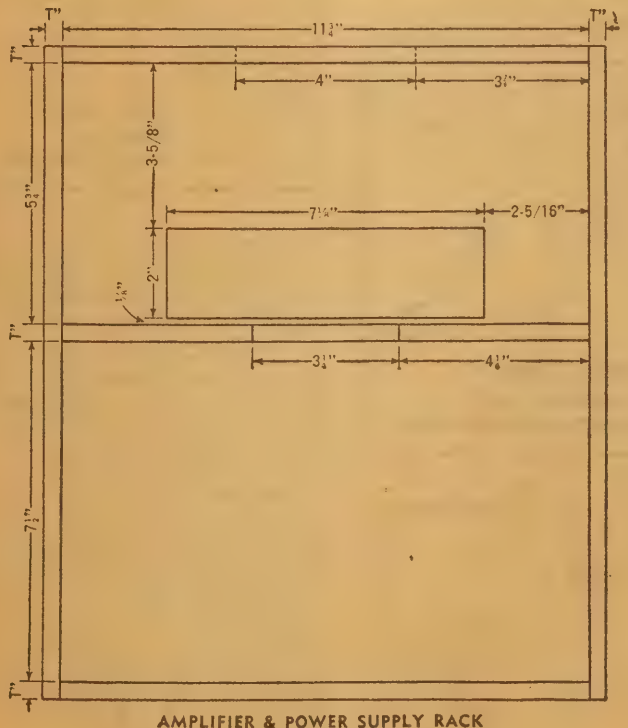
DETAILS OF THE COMPOSITE AMPLIFIER CABINET



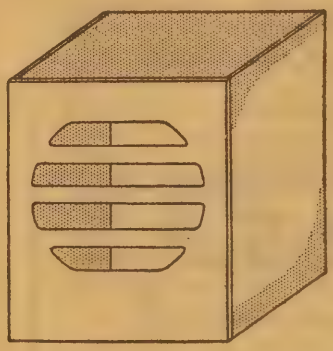
FRONT ELEVATION OF SPEAKER CASE
(¼ Scale)

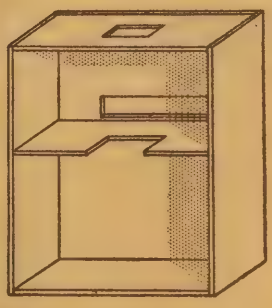


SIDE ELEV. OF RACK & SPEAKER CASE
(¼ Scale)



AMPLIFIER & POWER SUPPLY RACK
(¼ Scale)





NOTE: "T" INS. IS THE THICKNESS OF THE MATERIAL USED

With the detailed measurements given above you should be able to duplicate the carrying case and rack made up for the original unit. The shelf in the rack can be mortised into the sides or held in place with blocks. Note that the thickness of the timber used must be taken into account in certain measurements. A dressed finger-hole below the cut-out for the controls would allow easy removal of the rack from the case.

MAGNETIC AMPLIFIER CIRCUITS

The magnetic amplifier, like the transistor and the dielectric amplifier, is an electronic device which is currently undergoing extensive exploitation as a vacuum tube substitute. Like these promising contemporaries, it has advantages in certain applications which make its use preferable to the electron tube. This article discusses these advantages and the operating principles which make them possible.

THE major field of application for the magnetic amplifier at the present time is in industrial control circuitry such as AC and DC motor speed control servo systems, voltage and current regulators, temperature controls and industrial safety circuits.

The sphere of usefulness is rapidly being expanded, however, to include audio and radio frequency amplification for communication purposes extending up to several megacycles.

These advantages are being made possible largely because of improvements in the ferromagnetic materials employed in the saturable reactors. These include the grain-oriented silicon steels and gapless toroidal cores.

Strides are also being made in improved circuits and better selenium and germanium rectifiers for use in amplifier circuits.

The magnetic amplifier is useful because of its high power handling capabilities, low cost (intermediate between that of tube and dielectric amplifiers), and extreme ruggedness.

It is being applied to power amplifications ranging from a few watts to thousands of kilowatts. Its economy and reliability are certain to assure it a permanent place in electronics.

The magnetic amplifier completes the family of electronic devices which function because a control voltage causes a variation in one of the basic electrical properties of a circuit component.

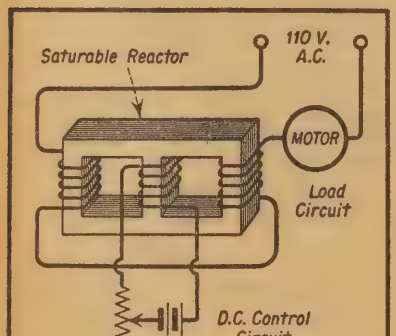
The vacuum tube amplifier, for example, may be thought of as a device in which a change in the control voltage on the grid causes the cathode-plate resistance to vary.

In the dielectric amplifier a change in a control voltage effects a change in the capacitance of a condenser and therefore its reactance.

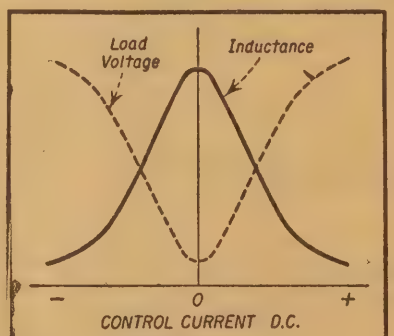
In the magnetic amplifier, the variation of a control voltage brings about a change in the inductance of a coil and, hence, its inductive reactance.

In all three cases, the control power required to effect the change is less than the power controlled, so that the devices are classed as amplifiers.

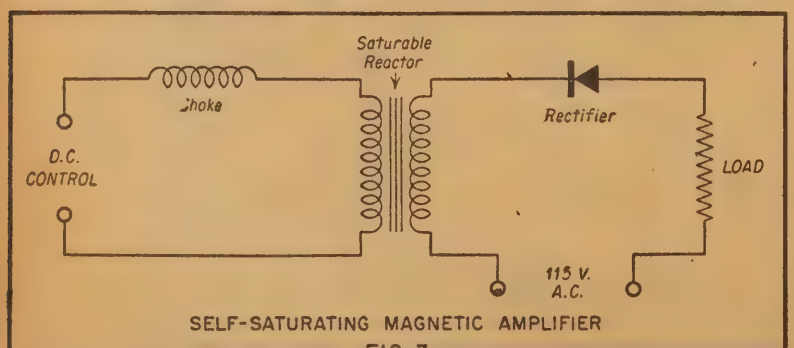
The saturable reactor, which is the basis of magnetic amplification, functions because of the ferromagnetic properties of the core materials utilised. A simple saturable reactor which will illustrate this principle is shown in Fig. 1.



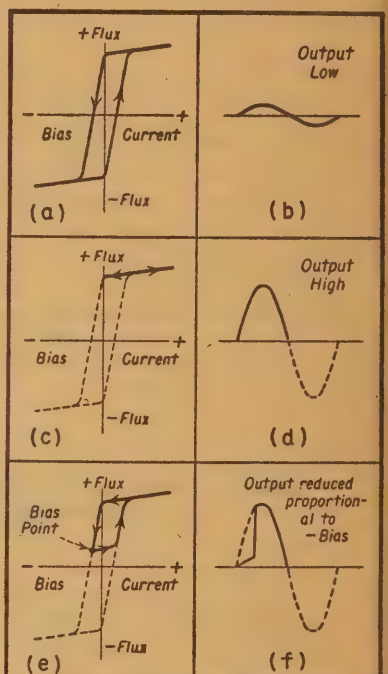
ELEMENTARY MAGNETIC AMPLIFIER
FIG. 1



RESPONSE OF SIMPLE SATURABLE REACTOR
FIG. 2



SELF-SATURATING MAGNETIC AMPLIFIER
FIG. 3



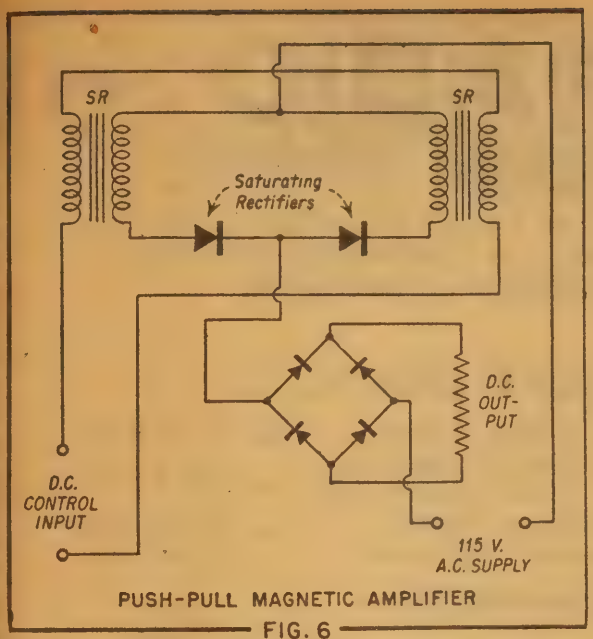
ACTION OF SELF-SATURATING AMPLIFIER
FIG. 4

Three windings are arranged on the "E"-type transformer core and connected as shown. The alternating current to be controlled flows in the windings on the outer legs and the DC control current flows in the centre leg-winding.

Note that this arrangement prevents the induction of alternating current from the load circuit into the control circuit because the flux produced by the outer coils cancels in the centre leg.

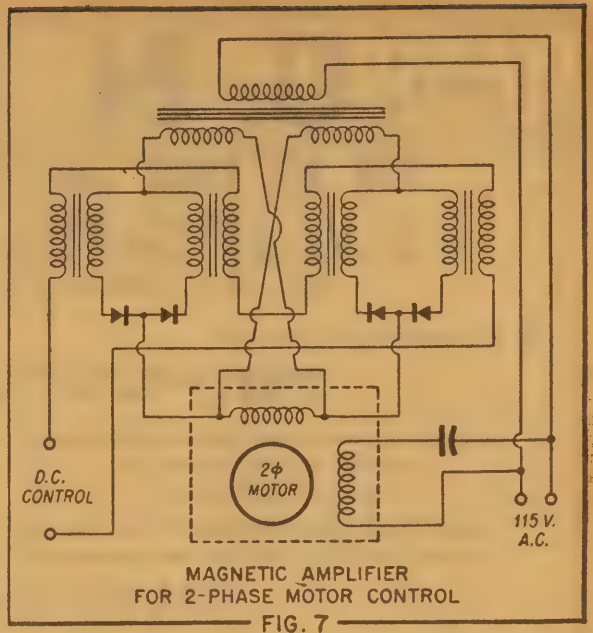
The control winding, on the other hand, can produce saturation of the core material. The inductance of the AC coils is directly proportional to the permeability of the core, and the inductive reactance is directly proportional to the inductance.

The way in which the load circuit inductance varies with DC control is shown qualitatively in Fig. 2. The reactance, and hence the voltage, drop across the coils is maximum



PUSH-PULL MAGNETIC AMPLIFIER

FIG. 6



MAGNETIC AMPLIFIER FOR 2-PHASE MOTOR CONTROL

FIG. 7

when the control current is zero and minimum when the core is saturated. Thus, the power applied to the load is a function of the DC control current.

Simple magnetic amplifiers of the type illustrated in Fig. 1 are not capable of high gain performance. They have been almost completely superseded by improved magnetic amplifers of the self-saturating variety. The basic circuit of this type is shown in Fig. 3.

Here a rectifier having a high front-to-back impedance ratio is inserted in series with the load circuit of a saturable reactor. The DC control circuit is isolated from the load AC by inductance.

Improved amplifiers of this type, when used in conjunction with the new square magnetisation-loop core materials, are capable of power gains approaching one million.

TYPICAL CASE

To understand the operation of self-saturating magnetic amplifiers, let us examine the typical magnetisation (or hysteresis) loop of Fig. 4a. This has the kind of steep-sided, easily saturated characteristics required of the saturable reactor in the circuit of Fig. 3.

In the absence of control current and without the rectifier in series with the load, the operating point would trace out the entire magnetisation loop each AC cycle. The resulting output wave would then be as in Fig. 4b.

The insertion of the rectifier eliminates alternate half-cycles of the output wave as in Fig. 4d and produces a DC component in the load circuit which saturates the core in one direction during conducting half-cycles. The locus of the operating point is shown then along the saturated top of the loop, as indicated by the solid line in Fig. 4c.

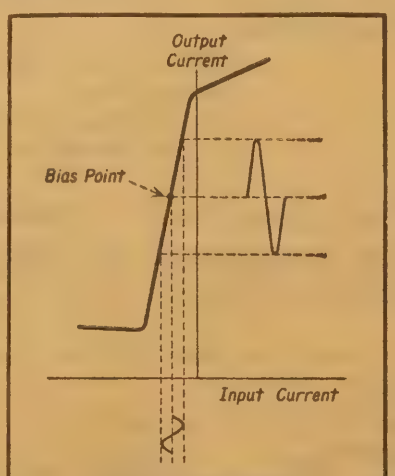
The core remains saturated since the rectifier prevents the flow of current in the negative direction required to produce demagnetisation.

The output voltage is maximum under this condition, since the continued saturation of the core results in low inductive reactance in the load coil and, hence, low voltage drop across it.

Now, suppose that a DC control current is introduced in the control winding in a direction which tends to produce saturation of the core in the direction opposite to that produced by the rectified load current. Then, during the half-cycle when the load rectifier is not conducting, this control current reduces the magnetisation of the core to some value on the negative-going part of the loop, as in Fig. 4e.

If the value of this bias current is large enough, it may even saturate the core of the reactor in the reverse direction. When the rectifier again conducts, it overcomes the effect of the control current and again saturates the core as in 4c.

To do so, it must re-establish the flux density which was reduced by the negative control current. Note that the amount of flux which the load current must set up before it again saturates the core is directly proportional to the control if the hysteresis loop has essentially straight sides.



TYPICAL TRANSFER CHARACTERISTIC

FIG. 5

Since it takes a finite time for the load DC component to produce saturation of the core, depending upon how close to negative saturation the control current has driven the core, the effective output voltage is reduced until positive saturation is reached. This results in the normal output waveform of Fig. 4d being modified as in Fig. 4f.

The amount of load power reduction is directly proportional to the flux increment required to saturate the core from the bias point.

The distortion of the voltage waveform results from the fact that the flux increment induces a back-voltage in the load coil which opposes the applied load voltage. In other words, the inductance of the load coil is high until the core reaches saturation.

The control circuit thus controls the output power by controlling the flux increment required to reach saturation. The gain of the amplifier is large if the slope of the magnetisation loop is large so that a small change in control current produces a large change in output current.

A typical control characteristic would appear as in Fig. 5. Like the dielectric and vacuum tube amplifiers the magnetic amplifier operating point may be set to any part of the control characteristic by the application of a fixed DC bias. When used as a DC amplifier, the device has the properties of the long sought "DC transformer".

MANY VARIANTS

There are many variants of the basic self-saturating magnetic amplifier discussed above.

Fig. 6 shows a full-wave circuit using two saturable reactors, two saturating rectifiers, and a bridge rectifier for DC output to the load. The saturating rectifiers are connected so that one load coil conducts on positive half-cycles and the other conducts on the negative half-cycles of the supply voltage. The control windings are in series. This connection gives the highest input impedance.

(Continued on Page 83).

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A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

REMOTE SPEAKER, ON-OFF SWITCHING FOR YOUR SET

Where an extension speaker is used, the inconvenience of having to leave the room (or bed in the winter time) to switch off the radio can be overcome by equipping the unit with an ON-OFF switch.

N the system outlined here, the 240V mains are entirely isolated om the extension unit, a low-volt- e transformer and rectifier are em- oyed to provide DC to a pair of terlocked relays which perform the sired switching, and the same push- itton switch is used for both on and f switching.

Refinements in the circuit consist a local-remote switch and speaker lector fitted to a separate relay unit, gether with normalled telephone ck-and-plug facilities which allow e receiver to be isolated and used parately if and when desired.

The extension speaker should be ounted on a baffle or in a suitable ox. Additions to this unit consist of small push-button switch (S3 on the rcuit diagram) wired across the line, id a series potentiometer to provide local volume control at the exten- on unit, without again having to to the receiver once the latter has en set to the desired station.

By using non-shorting jacks at the he terminations and an associated ug on the unit, it can be trans- orted from room to room.

HE RELAY UNIT

The components used in the relay nit should be arranged on any con- enient chassis and contained in a itable box which can be mounted ear or inside the receiver cabinet.

No special arrangement is required it, since the local-remote switch S1) and the speaker selector (S2) gether with the outlet socket have be visible and accessible, they ould be arranged as symmetrically s possible and designated accord- gly.

The normalled jacks and plugs indi- ated may be dispensed with if de- red, but they are included as a re- nement to allow the receiver to be olated and used normally.

Where an extension speaker has ready been fitted using an arrange- ent other than capacitive coupling om the anode of the output valve, it ould be modified to this circuit. he capacitive coupling ensures that here is no DC path through the line interfere with relay operation.

In any case, modifications are ecessary if normalled telephone ck-and-plug facilities and external peaker selector are to be included.

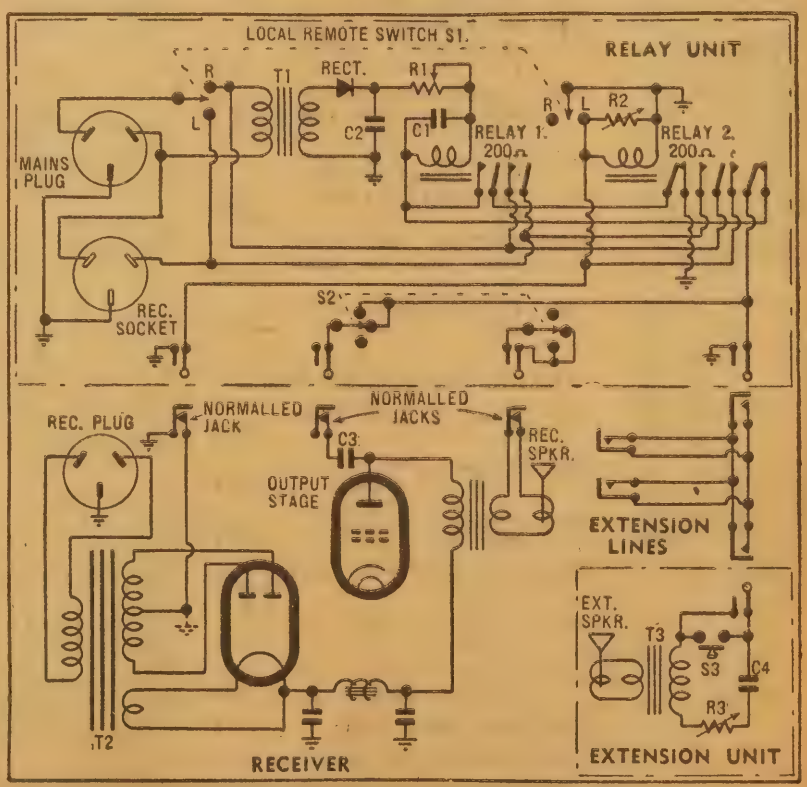
The only other circuit change ecessary in the receiver is the in- usion of the coil of the hold-in lay (REL2) in the HT negative turn.

Since the coil resistance of this relay is approximately 200 ohms, and this with the total current drain of the receiver develops only 8 to 12 volts, it can be seen that the effect is merely to reduce the total HT by this amount, and, therefore, does not interfere with the normal operation of the receiver.

An adjustable shunt resistor is used in parallel with the coil to obtain optimum operation without

(Continued on Page 83)

- T1 Transformer, 240V. primary; 30 to 60V. secondary.
- T2 Already in receiver power supply.
- T3 Speaker transformer used in the extension speaker.
- R1 500-ohm, wire wound, 5W., fitted with adjustable clip.
- R2 200-ohm, 5W., wire-wound, adjustable.
- R3 5000-ohm potentiometer.
- C1 400 mfd., 12V.P. electrolytic.
- C2 8 to 16 mfd., 50-100 V., electrolytic.
- C3 0.5 mfd., 400V.W., paper or foil.
- C4 0.5 mfd., 200 V.W. paper or foil.
- RECT1 Single or double element copper oxide or selenium rectifier. 100 mA rating.
- REL1 Relay, 200-400 ohm coil resistance fitted with two "make" contacts. (12 to 20V. operation).
- REL2 Relay, 200ohm coil, 12V., fitted with one "break", one "make" and one change-over contact set.
- S1 D.P.D.T. switch, 240V., 3A.
- S2 Oak type wafer switch, two pole, three position.
- S3 Push-button bell switch.
- Jacks. Normalled single-circuit telephone jacks on all except the control line.



The normal receiver circuits (bottom left) are adapted to feed through the additional circuits at the top. The speech line is then run around the house as required with outlet jacks. Extension speaker unit is shown bottom right.

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AERIAL COILS

Type No.		
AC1	Midget B/c Aerial Coil, iron-clad coils, etc.	12/8
AC2	Ditto Car Radio type	14/2
AC3	Second Band Pass Aerial Coil for BP2 Kit	12/8
AC4	Standard Medium gain B/c Aerial Coil	11/4
AC5	Standard Size High Gain, Iron-clad B/C Aerial	12/8
AC7	Standard Size Car Radio Type Aerial Coil	18/11
AC8	Standard Size No. 2 Coil Band Pass Kit	16/1

OSCILLATOR COILS

O1	1R5 Oscillator coil — on 100,000w resistor	7/7
O2	Midget Osc. Coil, to suit 1R5, 6J8, 1A7, etc.	12/8
O4	Midget Osc. Coil, to suit ECH33, 35, X61M, 6AN7, 6AE8, etc.	12/8
O5	Midget Osc. Coil, to suit, 6BE6/6SA7	12/8
O7	Standard Osc. Coil, to suit 6J8, 6A8, etc	12/8
O9	Standard Osc. Coil to suit ECH33, 35, X61M, 6AN7, 6AE8 etc.	12/8
O10	Midget 1600 Kc Osc. Coil, to suit O9 converters above	14/7
O11	Standard size Osc. Coil, to suit 1600 Kc-1900 Kc I.F.'s converters as for O9	14/7
OME	Magnetic Bias Oscillator Coil, for erase and bias	18/11
AO1	Pocket 455Kc alignment oscillator	97/9

RADIO FREQUENCY COILS

IC1	Ignition Hash Filter Car Radios	1/6
RC9	Untuned RF coil or 16MH RF Choke	3/9
RC1	Midget B/C RF coil, iron-clad	12/8
RC2	Ditto, but car radio type	14/2
RC3	Midget RF with reaction	14/2
RC4	Standard RF coil, medium gain	11/4
RC5	Ditto, high gain	12/8
RC6	Midget Reinartz	14/2

Type IF1

Type IF8

Type IF3

Type IF10

Type IF14

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Type No.		
IF1 & 2	Midget 455 Kc Medium gain I.F.'s	18/
IF3 & 4	Standard 455 Kc medium gain I.F.'s	15
IF8 & 9	Standard 455 Kc high gain I.F.'s	18/
IF10 & 11	Stand 455 Kc high gain Battery type	17
IF12 & 13	Midget 1600 Kc medium gain I.F.'s	18/
IF12A	Midget 1600 Kc's Broad Band I.F.'s	18/
IF14 & 15	Standard gen. purpose 1900 Kc I.F's	18/
N.B.	2 I.F.15's for broad band width sets.	

SHORT WAVE COILS

AER	RF Ocs 13M or 16M	6
AER	RF Osc 50M	8

TUNING UNITS, KITS, ETC.

DW4	Midget single stage unit B/C plus 16-50M, suit 6J8, 6A8, converters, etc	70/
DW5	As above but for ECH35, X61M, 6AN7, 6AE8 converters	70/
DW6	As above but for IR5 converters	70/
DW7	As above but for 6BE6/6SA7	70/
DWR4	As for DW4 but with RF stage	132
DWR5	As for DW5 but RF also available with 13-42M SW band	132
DWR6	As for DW6 but with RF stage	132
DWR7	As for DW7 but RF	132
BP1	Standard size Band Pass, Hi. Fi. Coil and I.F. Kit	83
BP2	Midget size band Pass, Hi. Fi. Coil and I.F. Kit	83
CRK1	Midget Car Radio coil and I.F. Kit	79
CRK2A	Midget Car Kit W/O RF coil—Std aerial	69/
CRK3	Midget Car Radio coil and I.F. kit with super gain aerial coil	84
RFC1	2.5MH RF Choke	3
RFC2	2.5MH RF Choke 4P1	5
RFC3	2.5MH RF Choke, iron-cored	3
USW1	Unwound S/W former with core	4
SW	S. Wave coils, all types	
WFC1	10 Kc. Whistle Filter choke	5
CD	Coil Dope	3

BUY Q-PLUS AND POCKET THE SAVINGS

REMOTE SPEAKER SWITCHING

(Continued from Page 81)

verrating the coil current; this re- stor may be dispensed with in ost applications where the receiver rain is approximately 60 mA.

The relay unit should be plugged to the normal room outlet and the eceiver plug inserted in the three- in socket on the unit. The ocal-remote switch should be set "remote" and the speaker selec- r set to the position which allows oth speakers to be operated to- ether. (The operation of this peaker selector is obvious.)

Pressing the button switch S3 on ie extension unit completes the cir- uit to earth (via the line) for relay REL1) which is energised from the C supply obtained from the secon- ary of T1 and the associated metal ectifier element (RECT1).

REL1 locks in via its own make ontact (1) and the break contact 1) on REL2 (not yet operated).

Contact (2) on REL1 completes ie circuit to the receiver transfor- ier (arbitrarily designated T2 for urposes of reference).

When HT becomes available and ie return current to the centre- ap of T2 reaches the operate-value f REL2, this relay closes and in so oing its contacts:

(1) Break the circuit for REL1.

(2) Bridge around contact (2) on EL1 to maintain the circuit to T2 rimary.

(3) Remove the line from the coil of REL1 and apply it to its own coil; this coil is therefore connected directly across the line.

When the circuit to REL1 is broken by the opening of contact REL2/1, the former relay does not release immediately, but is delayed from doing so by the high value of shunt capacitance C1. This delay is necessary to allow contact REL2/2 to maintain the circuit to T2 before the changeover of relays takes place.

After the above action is complete, the receiver will continue to operate normally and may be switched off either at the wall switch or on the front panel if desired.

To switch off at the remote point the push-button switch S3 is again depressed, and in this instance now shorts out the coil of REL2.

Resistor R1 in series with the coil of REL1 makes this relay slower to operate than REL2 is to release, and thus does not allow it to close and so begin the switch-on cycle. The actual adjustment is dependent on the voltage available at the secondary of T1 and the value of REL1 coil together with the value of C1.

The action of pressing the button for initial switch-on should take a moment longer than switch-off, and with a little practice and careful adjustment of R1 optimum results can be obtained in a very short while.

MAGNETIC AMPLIFIER CIRCUITS

(Continued from Page 79)

Typical performance figures for n amplifier of this type are:

Input impedance ... 450 ohms.
Load impedance .... 2000 ohms.
Supply voltage 110 volts and 60 cps
Maximum power output 15 watts
Maximum power gain .. 200,000
Weight ..... 3lbs.

A further extension of the basic elf-saturating circuit is shown in ig. 7. This push-pull connection s arranged to control the speed of 2-phase motor.

Through the use of a high gain mplifier of this kind, the power equired to control a large motor relatively small and can be de- ived from a small rheostat, an lectronic tachometer, or some ther sensing device.

The magnetic amplifier is a com- aratively low input impedance de- ice, whereas both the vacuum tube nd dielectric amplifiers have high nput impedances in most circuit onnections.

For this reason, the magnetic type frequently combined with these ther kinds in applications which equire high input impedance.

Like the dielectric amplifier, the utput circuit of the magnetic am- lifier must be supplied with al- ernating current since variable re- ctances are involved, while the acuum tube plate circuit is usual- supplied with DC. For satis- actory reproduction of the output ave, the AC supply frequency hould be at least five times higher han the highest frequency handled.

Both the dielectric and the mag- netic amplifier of the simple type of Fig. 1 act as frequency doublers when operated at the zero bias point because either a positive-going or a negative-going signal produce an increase in output.

The signals are 180 degrees out of phase, however, since at zero bias the output of the simple saturable reactor is minimum while that of the dielectric is maximum.

The self-saturated magnetic amplifier more nearly resembles the vacuum tube in phase relationships.

The dielectric amplifier, the transistor, and the magnetic amplifier have the advantage of requiring no filament power or warm-up time as with the vacuum tube type.

The dielectric and magnetic amplifiers have the additional advantage of requiring no precision constructional techniques such as are needed in fabricating vacuum tubes and transistors. Both are characterised by almost infinite life and ruggedness.

The magnetic amplifier is also considerably better than the dielectric and transistor amplifier from the standpoint of temperature dependance.

(By courtesy of the Aerovox Corporation.)

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A GUIDE TO TAPE DECK DESIGN

Readers who have access to a lathe can adapt the components from a rim-driven turntable for a complete and efficient capstan drive unit. In this concluding article, our contributor tells you how to go about the job.

By P. D. THOMAS—Part Three

IF a complete capstan drive unit is built for the job, its performance will naturally be better. The serious experimenter will probably desire to do this. The precision work involved, however, may deter him, particularly if he lacks a lathe.

The unit shown as a side view in fig. 9 makes use of one or two short cuts and can be built using only hand tools provided the flywheel, capstan, and motor bushing are turned to order.

The motor and idler wheel assembly is taken from a rim-drive gramo motor — in the author's model, from an MU 10, which suited the purpose very well. This provides all the essential items for this part of the unit, and saves a lot of tedious work.

The 78 rpm bushing on the motor can be turned down to the required diameter — 3-10in—and the rubber mounting grommets and spacing collars are also used, as in the original unit.

The framework of the unit consists of top and bottom plates, spaced by four rods or lengths of tubing. The motor and idler wheel assembly is transferred to the bottom plate, which is drilled exactly as the original mounting plate of the motor.

Figure 10: A plan view of the motor platform showing the idler wheel and mechanism. For the complete mechanism see figure 9 opposite.

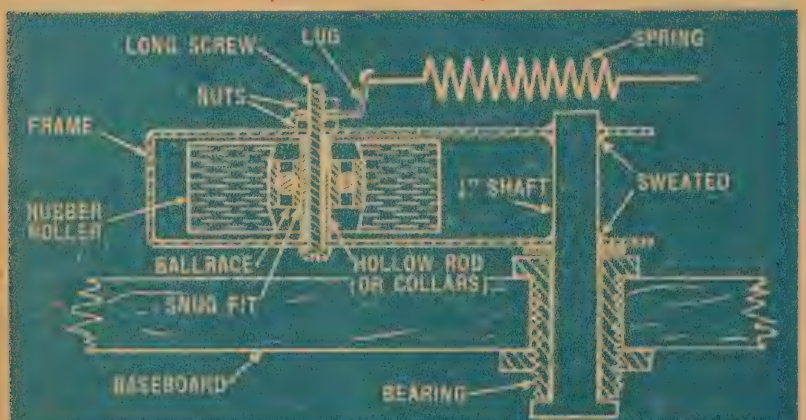

Figure 11: A simple method of making a low-drag pressure wheel. Possible variations from this scheme may suggest themselves.

SPINDLE RACES

A ball race and housing is mounted on each plate, and these bearings support the main spindle laterally. The combined flywheel and drive wheel between the two plates, rests on a simple thrust race which in turn rests on the bottom plate. This takes care of the vertical thrust very smoothly.

A single ball could be used as the thrust bearing, but this is not recommended as it could cause trouble unless it were very accurately centred.

The flywheel is secured to the spindle by two diametrically-opposed grubscrews. The capstan is mounted on the top end of the spindle, which projects through the top plate. Its height can be adjusted by slackening the flywheel grubscrews and easing the spindle up or down through the bearings, which are, of course, a push fit.

Having obtained the materials, proceed with the construction as follows. Cut the top and bottom plates to size and drill the necessary holes, using fig. 10 as a guide to mark them out. Five holes are common to both plates —the hole for the main spindle, and the four holes in the corners for the spacers.

TWO PLATES

The easiest way to drill these holes is to mark out the top plate, then clamp them in the vice and drill two of the corner holes through both plates.

Bolt them together with these holes then the other holes can be drilled as though through a single plate, and the alignment will be perfect.

The motor mounting holes in fig. 10 are correct for the MU 10. If a different motor is used they will naturally have to be made to suit. No holes are shown for the ballrace housings, as these will be drilled to fit the housings available.

Three or four holes must also be made in the top plate to fix the unit to the main baseboard; these must be positioned to fit in with the individual layout, and have likewise not been indicated in the diagrams.

For these plates, 1-8in steel plate is desirable, but 1-16in plate should be thick enough and is easier to work.

The four spacers should preferably

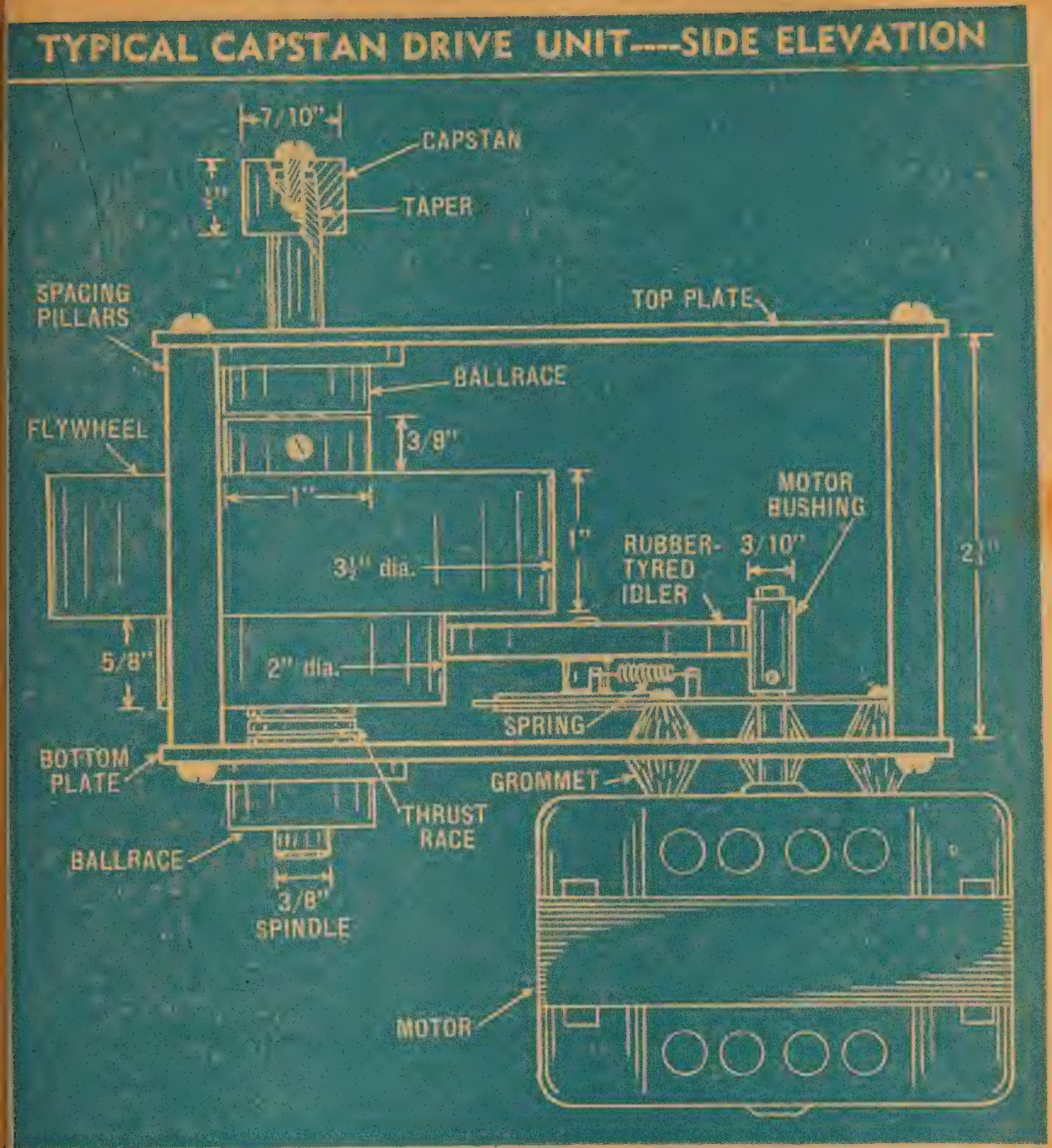

Figure 9: This drawing contains all the essential information for the construction of your own tape drive system. For plan view of motor platform, see figure 10 on the opposite page.

be of 3-8in steel rod, drilled and tapped at each end for 4in Whitworth screws. However, if this is too difficult, use thick-walled tubing and four 3in lengths of screwed rod with nuts at each end.

In order to get the most favorable angle between the three spindles with the MU 10, the small plate which carries the idler must be modified slightly. Using a small rat-tail file, slot the three holes which take the 4 BA assembly screws to the extent of about 3-16in. When the unit is assembled, the angle can be adjusted to make the best use of the spring loading by using these slots. Fig. 10 shows the best arrangement.

Turning the flywheel is a straightforward job. The only critical dimensions are the bore, which must be a good, snug fit on the spindle, and the diameter of the driven portion.

The capstan must be carefully turned and fitted to the spindle, since it must be perfectly true to avoid wow. If possible, it should be finally lapped when mounted on the spindle.

Either steel or brass can be used for both flywheel and capstan, though ideally steel should be plated to prevent rusting.

Silver steel rod is the obvious choice for the spindle.

Before the final assembly, check that the various parts fit together correctly. The ball races should be a fairly tight push fit on the spindle; if they are too tight, the spindle can be rubbed down with emery cloth, but be careful not to remove too much metal.

If they are a loose fit, the spindle can be built up by knurling it very slightly at the points where the races must fit, or by nicking it slightly with a cold chisel.

The thrust race consists of two steel discs with the race itself sandwiched between them. The flywheel bears on the upper disc; the lower one rests on the bottom plate. They are completely free of the spindle.

It is a good idea to interpose a

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lt or leather washer between the ›wer disc and the bottom plate to ›low for any slight misalignment, hich would cause noisy or uneven inning. When buying them, specify ecision and not industrial bear-gs.

When everything is in order, clean › the plates and spacers and give em a coat or two of enamel and semble the complete unit. Check at everything turns freely, and nnect the motor to the power. The nit should run smoothly and quietly, ithout noticeable vibration.

If a speed of 15 ips is required, is only necessary to turn up an-her motor bushing, 6/10in dia-ieter.

If the use of a lower speed than ips were contemplated, it would e better to reduce the size of the apstan at the start. In this case ie top of the spindle could be turned own to 7/20in, and this would then erve as the capstan.

RESSURE ROLLER

The 3/10in motor bushing would ien give a tape speed of 3¾ ips, nd a 6/10in bushing would give ips.

Having provided for a capstan, a ressure roller is the next require-ient. The roller itself must be true nd smooth-running, as it is possible or loose or rough bearings to cause utter. As a general rule, the smaller ie capstan, the more carefully must he pressure roller be made.

Rubber is most commonly used, ither in the form of a solid roller r as a rubber-tyred wheel. It is atisfactory to make it the same vidth as the capstan—say, half an nch—and the diameter can be an nch to an inch and a half for most apstans. This is not critical, except n special cases.

The simplest bearing is formed by orcing a metal bushing through the entre of a rubber roller, which can ear on a fixed spindle of correct iameter. This is quite satisfactory, hough it is difficult to lubricate the earing adequately without getting il on the rubber.

A better system uses a small ball race, say 3-8in overall diameter, or slightly larger. This is fitted tightly to a fixed spindle, and is forced into a hole, slightly smaller than its outside diameter, through the rubber roller.

If a spindle of the correct size is lacking, the centre of the ball race can be clamped to a long bolt or screwed rod by placing a collar on each side.

Fig. 11 shows the assembly in cross-section, with a simple framework made of a U-shaped strip of metal sweated to a vertical rod. This could be an old volume-control shaft, and its bearing, mounted on the baseboard, will support it very neatly and allow it to turn.

The roller assembly must be spring-loaded. At the same time there must be provision to swing it out of the way while the tape is being threaded.

Fig. 12 illustrates one approach to this problem. A tension spring stretched from the top of the frame (Fig. 11) to a fixed pillar on the baseboard provides the spring loading, and also a toggle action, so that when the roller is pulled away from the capstan it comes to rest against a stop in the position shown in broken lines.

With a little more work, the spring and stop could be similarly arranged below the baseboard.

A fairly hard rubber is best for the roller; this can be turned like wood with a little care, though it will blunt the tool very rapidly. A useful source of rubber is a large door stop. The centre hole can be drilled with an ordinary twist bit, starting with a small hole and gradually enlarging it.

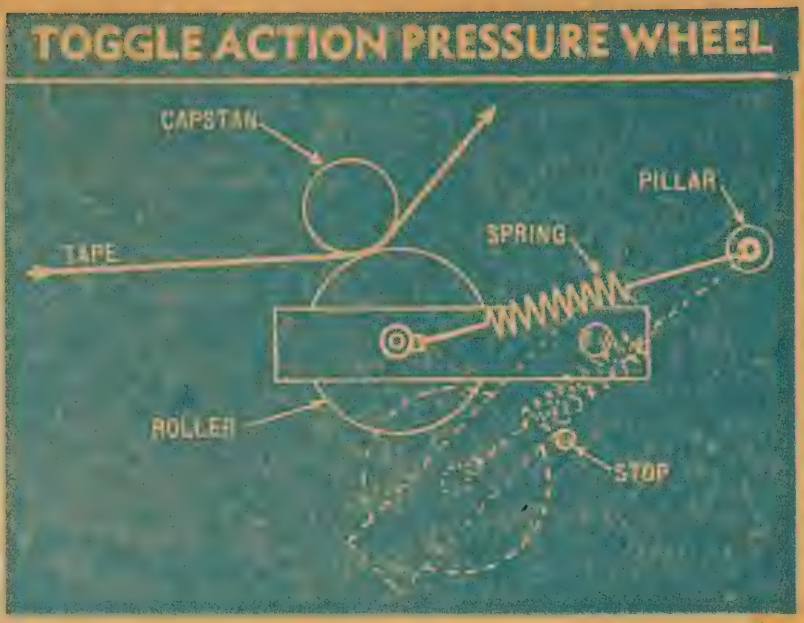

Figure 12: By suitably arranging the spring, the pressure wheel will press against the capstan or remain hard against the stop as described.

DECK LAYOUT

Assuming that the constructor has decided on a basic drive system, the next question is the choice of layout. Unless a specific set of motors, heads, &c., is used, no concrete layout can be described, and it will have to be worked out on paper first.

To eliminate the mistakes and unknown quantities which will be almost inevitable in a first attempt, it is worth while to make a "mock-up" of the chosen design by mounting the motors and heads on a rough wooden framework, perhaps on a sheet of masonite or plywood. The running of the tape can be checked and problems of switching, head mounting, &c., worked out.

If any alterations have to be made —and inevitably there will be some —these can be tried out without spoiling an expensive baseboard. The hum picked up by the head can also be checked.

When the design seems to be satisfactory, the recorder can be built in its final form, following exactly the same layout, with the knowledge that it will be successful.

It is usual to mount the motors and heads, &c., on a single rigid baseboard, or motor board, of appro-

Figure 13 A suitable layout for a home-made deck. Factors governing choice of layout were outlined in earlier issues.

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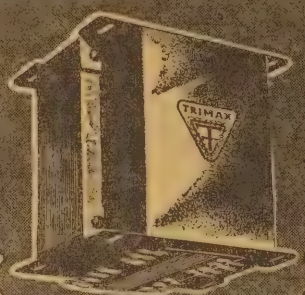

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riate size to accommodate these nd the reels. This may be metal, asonite, plywood, plastic or any itable material. There is a risk using iron or steel that eddy irrents, induced by the motors, ay cause excessive hum to be picked by the head. Unless the motors e mounted on a sub-panel some stance below the main baseboard, is safer to avoid these materials.

The most important factor in noosing a baseboard is rigidity, to event any flexing which might low the head to move in relation the capstan. However, there is tle point in having a rigid base-oard if the capstan mounting is pos-xible that such movement is pos-ble, so the capstan assembly must e rigidly mounted.

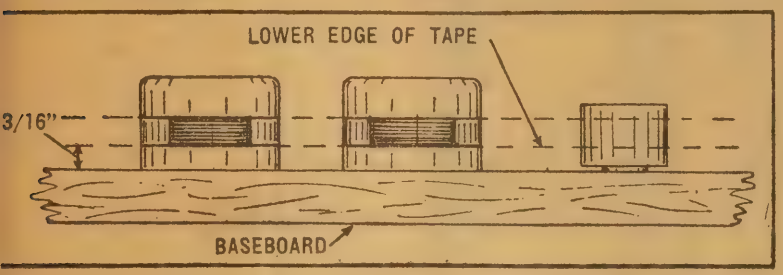

Figure 14 – Illustrating the position of the tape in relation to the deck. Heads, guides and pulleys must all line up with this dimension

Alternatively, the heads can be ttached to the plate which carries ne capstan bearing, and isolated rom the baseboard.

The reel motors or spindles are ot so critical, and it is better to use slightly resilient mounting for nese, to reduce noise and vibration.

VERTICAL PANEL

There is some advantage in a ver-ical panel mounting, which is used n many professional recorders. The notor bearings and mountings must e suited to this purpose, but apart rom this the same system may be ised.

Assuming the use of a pair of com-nercial heads, two reel motors, and capstan unit and pressure roller uch as that just described, a reliable ayout is that shown in Fig. 13.

From the rewind reel, the tape urves around the front of the first uide, and the back of the second. t passes the erase and record-play-ack heads, curving slightly so that keeps in good contact with the aps; squeezes between the capstan nd the pressure roller, and finally vinds on to the take-up reel.

For a short fast forward or re-vind run, it is only necessary to re-ease the pressure roller and lift the ape off the second guide. This will elieve the friction at the heads. For complete rewind it is not difficult o lift the tape completely off the uides and heads, and let it run traight across from one reel to the ther.

The switches can be placed in the ront right-hand corner, handy to the ressure roller. The circuit of Fig. c is ideally suited to this layout.

To avoid spilling and breaking loops f tape, it is essential to keep it close o the baseboard. Owing to the thick-ess of the reels, the limit is abou -16in. between the lower edge of the ape and the surface of the base-oard.

The height of the reel platforms should be adjusted so as to allow this. Thus the top of each platform and the lower edge of the capstan will have to be about 1-16in. above the baseboard. It is probable that the heads will be too high to line up with the tape, in which case they will have to be mounted in holes cut in the baseboard.

A similar layout could be adopted using a 78 rpm motor, but rather more space would be required to clear the turntable.

There are two main types of guides: fixed guides or pillars, and rotating guides. The former cause more friction and drag, and are more subject to wear, but are easier to make. A very simple but useful type consists of an old valve base, with the pins cut off, fixed to the baseboard with a single screw through a central hole.

A nearly perfect rotating guide is obtained by clamping the centre of a ball race to the baseboard with a screw and washers, so that the outside is free to turn.

Once this has been correctly aligned, the tape will automatically position itself in the centre, with no tendency to "walk" up or down. An outside diameter of ¾in and thickness of ¼in is very suitable.

At no point should the tape bend around a smaller radius than ¼in. This rules out very small diameter pulleys, though these are used in some recorders. It is better not to use flanged guides; if the reel motors and heads are correctly aligned, they are not necessary.

MINIMUM RADIUS

The tape should be free to move as much as 1-8in up or down without hindrance except at the heads. Then if the reels, &c., are mounted correctly the tape will assume the correct position of its own accord; if anything is wrong, the fault will be obvious and may be corrected before harm is done.

The gap of a commercial head is normally fixed with respect to its own guides, having been adjusted to the correct angle during manufacture, so it is only necessary to ensure that the tape runs through both heads easily without binding at any point. This would be caused by misalignment of the head mounting, or one head being higher than the other.

Figure 14 shows how the heads and capstan appear when they are correctly aligned.

The gap in each head should not point directly to the front, but slightly outwards, away from its neighbor. Then, as the tape curves around the faces of the cores, the gaps are in the centre of each area of tape contact.

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TRADE REVIEWS AND RELEASES

NEW LINE OF AEGIS COILS, IFT's

The Aegis Manufacturing Company has just announced a new line of coils and IF transformers which employ a simplified yet efficient method of construction. This allows them to be offered at a lower price than previously possible.

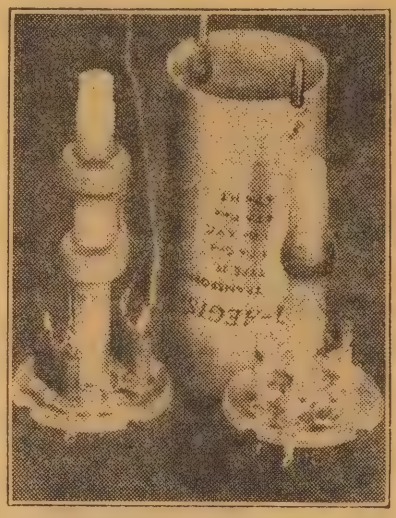
IN the new units, the coil former and base are moulded as a single piece from clear polystyrene. The base has an external shoulder which locates it positively in position, while the end of the former fits neatly through a hole in the top of the can. The whole assembly is thus held firmly in place.

Instead of being attached to the usual threaded brass rod, the iron cores in the new Aegis coils are simple slugs which are moulded with an external thread and a slot for screwdriver adjustment. A special non-metallic driver is available, although an ordinary knob driver can be used.

A corresponding thread is moulded inside the former and the core is thus simply screwed into position and lightly sealed, if desired, after alignment. The manufacturers claim that they can work to sufficiently close tolerances to avoid risk of the cores being either too loose or given to jamming.

The windings themselves have a smaller internal diameter than previously but are claimed to give a high "Q" factor, due to less damping effect from the shield can.

Silvered-mica type condensers are used in the I.F. transformers and the assembly is protected against moisture etc., by dipping in a special wax.



For connection into circuit, single-piece eyeletted lugs are provided.

The standard J9 and J10 IF transformers retail for 15/9 and the corresponding coils for 11/9. Supplies are available through all Aegis distributors.

ELMEC TAPE RECORDING HEADS

Illustrated below are two of the heads currently being offered by Elmec, of 60 Ferris St., Annandale, Sydney. They are specially designed with the needs in view of the home tape-deck constructor.

THE heads are provided with balanced high impedance windings, so that they are well suited for direct connection into simple tape recorder circuits.

Four types are available, namely half-track record/playback and erase and full-track record/playback and erase. All heads retail for the same price, £5/1/3.

The two half-track heads submitted for our inspection were neatly finished and plated and would mount easily on almost any deck. They have double gaps, which allow the heads to be reversed when one gap has become worn.

The manufacturers claim that the heads are capable of excellent results and are non-critical in relation to recording bias. A figure of 55Kc is suggested, with a tolerance of from 70 to 120 volts.

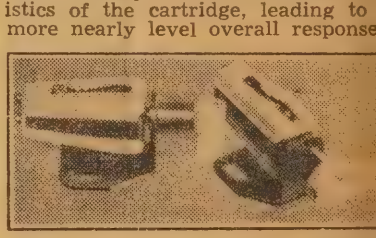
RONETTE CRYSTAL P.U. CARTRIDGES

Two new "Ronette" crystal cartridges have been released by AWA for use in 3-speed record players and changers.

THE two cartridges are identical in appearance but they are intended for different applications.

Type TO-284-N is intended for general industrial and domestic use with ordinary amplifiers and receivers. It is simply fed into 0.5 meg. load and the natural characteristics of the cartridge apply an acceptable degree of correction.

On 78 rpm records this allows a progressive drop of about 8-10 db in the treble register, which naturally minimises record noise. In LP discs however, the inherent treble accentuation broadly matches the characteristics of the cartridge, leading to a more nearly level overall response.



The second cartridge, type TO-284-P, is especially designed for use in higher quality systems and due attention should be paid to loading and correction networks. Properly used the manufacturers claim a substantially flat response over the whole range.

A novel feature of both pickups is that the two styli are completely independent mechanically, thereby eliminating free resonance effects from the unused stylus and also allowing the cartridge to track with lower pressure. The styli can be changed, when worn, without special tools.

A pamphlet giving details of the cartridges is available from AWA, 47 York St., Sydney. The cartridges are available for £2/13/- retail from the AWA Sales Department or from distributors.

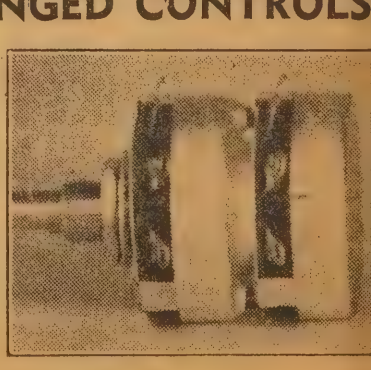
I.R.C. RELEASE GANGED CONTROLS

OF special interest to the trade is the recent announcement from Messrs. W. J. McLellan that they have released a line of ganged potentiometers.

The individual units follow the familiar IRC pattern but they are snugly mated in a fashion which minimises mechanical lag.

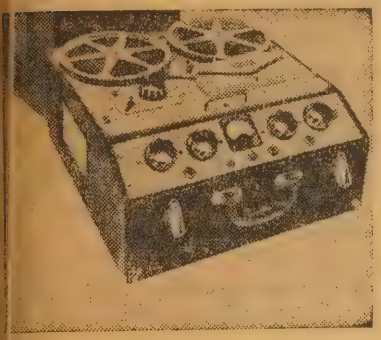
Though a limited selection will be treated as standard lines, the company can make up any combination of carbon or wire-wound units, in 2, 3 or 4-gang including a switch.

Full information is available from the manufacturers, W J. McLellan, 126 Sussex St, Sydney



NEW FERROGRAPH TAPE RECORDER

Tape Recorders Pty. Ltd., of Sydney, announce that stocks of the Ferrograph 2A tape recorder are now arriving in Australia. Already well known overseas, this model incorporates several new features which should prove popular with Australian users.



'OLLOWING are some of the features claimed for this model: New exclusive fading facilities allow superimposition of commentaries on previously recorded material. Erases unwanted passages without clicks or discontinuity.

Using 1800ft reels and half track recording it provides 45 minutes per side at 7½in per sec., total 1½ hours per reel, or 90 minutes per side, 3 hours per reel, at 3¾in per sec.

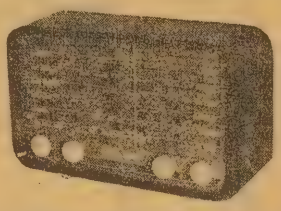
The frequency response is claimed to be from 50 cps to 10,000 cps within 3db at 7½in per sec, and a monitoring meter provides professional level control.

Other features are: Fast forward and rewind; cueing scale; 15 ohm extension speaker outlet; power supply socket for tuner; and a new redesigned carrying case.

Price, £165/10/-, plus tax. Further details from Tape Recorders Pty. Ltd., 183 Pitt St., Sydney.

IEALING ANNOUNCE THE "WINDSOR"

. G. Healing Ltd. announce the release of eir latest radio receiver to be known as the Windsor". This is a mantel set designed to ve the same performance as many console ceivers and has many features normally found only in larger sets.



'HE official designation is Model - 504E, "Windsor" 5V B/C Man-l Receiver and some of its feaures are as follows: The tuning nge is from 540 to 1600 kc. Power pply 200 250V AC 50 cps. Valves e 6BE6, 6BA6, 6AV6, 6M5, 6V4. he speaker is a Rola 6H of 6 5-8in ameter.

The controls are volume, continously variable tone, on/off switch d tuning. AVC is, of course, inuded in the circuit. A pickup cket is provided and is so arnged that insertion of the pick-up plug automatically silences the radio section. The dial is of moulded perspex and is calibrated for all States.

The cabinet is of moulded plastic and is 16in long, 10in high, and 6½in deep. It is available in an attractive range of colors including rosewood, ivory, blue and red.

Further details and price from A. G. Healing, 167 Franklin St., Melbourne.

ROLA TOUGH ENAMEL "D" WIRE

'HE Rola Co. (Australia) Pty. Ltd., announce a new enamel to e available on their winding wires nd to be known as Rola Tough namel "D".

This new Rola Tough Enamel "D" ombines some of the best features oleo-resinous and tough enamel ires. It will be available in a ull range of gauges and enamel dditions and, for the first time in ustralia, in a selection of distinctve colors.

The high degree of flexibility nd abrasion resistance possessed y Rola Tough Enamel "D" permits igher winding speeds than are posible with oleo-resinous type wires he electrical characteristics are uch as to permit the use in many pplications of a single instead of a ouble enamel wire, with a consequent space factor improvement anging from 3 pc in the heavy auges to 12 pc in the fine ones.

For the first time in Australia t will be possible to obtain an enmel covered wire which is inherntly color coded. Rola Tough namel "D" will be supplied in a ange of easily distinguishable colors, each baked into the insulating enamel and there for all time.

This enamel also possesses the valuable feature that it acts as a flux which, in many applications, obviates the necessity of stripping before soldering.

The makers claim that the electrical properties of this enamel are far better than any other which they have tested. Moisture does not appear to affect either the insulation resistance or the dielectric strength. In addition, a low power factor makes it suitable for use at radio frequencies. It also has an excellent heat resistance and is far superior in this respect to the oleo-resinous types.

The enamel is available in five colors, being red, orange, green, violet and clear. The use of these colors should assist manufacturers to provide an accurately color coded product without recourse to colored sleeving which is frequently damaged by the heat of the impregnating process.

Further information may be obtained from the Rola Co., The Boulevard, Richmond, Victoria.

Further to our Advt. of July 1953 issue:

The NEW

GRAMPIAN R.A.4

... is a new compact amplifier and power unit mounted on a single 12½in panel; the circuitry provides all facilities for 78 or 33 1/3 microgroove recording and the 40 V.A. output stage, when used in conjunction with our modified B1/AG feedback cutterhead (B.B.C. pattern), is capable of recording higher velocities than any standard pickup will trace and larger amplitudes than permissable in modern recording technique. Levels exceeding N.A.B. standards of 21 cm/sec are readily obtainable.

The unit is a development from the famous R.A.3a. laboratory model and contains such essential requirements as:

(a) Large output stage (40 V.A.)
(b) Variable H.F. Compensation.
(c) High Speed output Level meter.

Extensive field trials undertaken by independent recording studios indicate an outstanding performance of the R.A.4. amplifier and modified feedback cutterhead.

We feel this news is of the greatest importance to prospective users with a modest budget, for this is the first time feedback disc recording facilities have been made available within the means of all studios.

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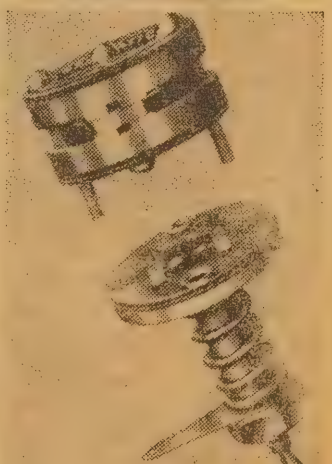

5RP and 5E, £6/6/-. 6RP £7/7/-. Response at 7½ ips:—5RP 30-10,000; 6RP 30-14,000.

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RAF Leather Flying Helmets, **35/-**, Speaking Tubes, **50/-**. RAF MK8 Goggles, **48/6**. MK7, **37/6**. Flying Boots, wool lined, **£5/15/-** pair. Stock and Die sets, ⅛in, ¼in and 1in water pipe, **£4/19/6**. Leather upper, wooden sole Clogs. Ideal for working in the wet, **25/-**. Sizes 7, 9, 10.

GENUINE AMERICAN KLAXON HAND OPERATED HORNS

Very loud. Ideal for Trucks, Boats, etc. Useful for Football Timekeepers, etc. BRAND NEW. £4/4/-.

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WILL PUMP ANY LIQUID

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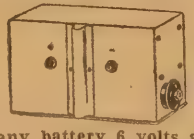

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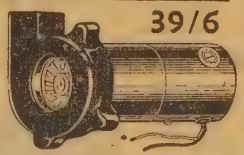
English Motor and Blower, 24 Volts
Will Work off any Lighting Plant.



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Eng. 0-40 Ammeters, 2¼ dial AC-DC	42/-
English 0-50 Ammeters, AC-DC	42/-
Eng. 0-3 Ammeters 2¼ dial, AC-DC	45/-
Eng. 0-150 Voltmeter, 3in Dial, Moving Coil	39/6
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Easily converted for use on dumpy levels.
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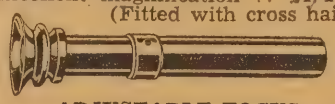

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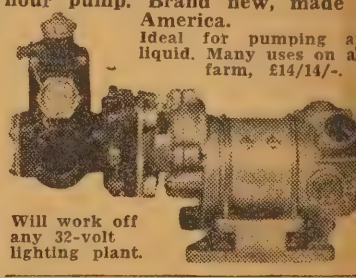

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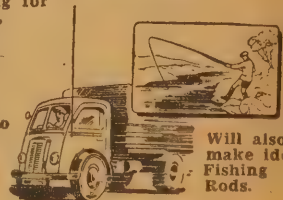
Too long for postage, advise nearest railway station.



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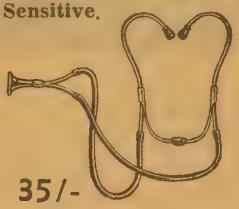

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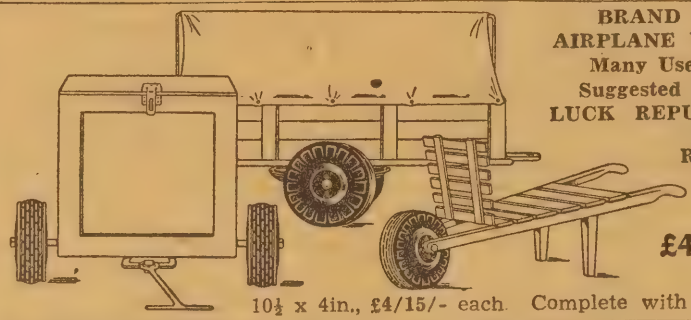

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LUCK REPURCHASE AT NEW REDUCED PRICE.

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Replace those broken side curtains with cellulose acetate which takes the place of celluloid and lasts four times longer. Will not discolor, 32/6 sheet.

Non-inflammable acetate sheet is recommended for all types of side curtain. Sheets are 20 thousandths of 1 inch thick. Size of sheet, 24in x 52in. Can be sewn or cemented into frames.

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Many uses on the Farm. Will transfer Petrol or any liquid from Drums, etc. WILL WORK from 12, 24 or 32 Volts AC or DC.

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6-volt 37/6 12-volt 25/-
Fitted with Mirror Reflector

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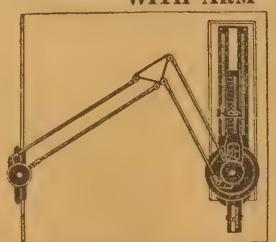

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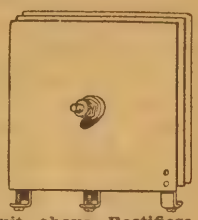

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What everybody has been waiting for. An Electric Engraver that works off your car battery.

Engraves anything in metal.

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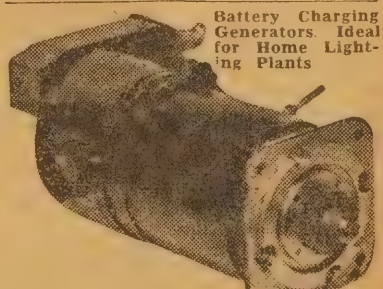
29/6

Engrave your name on all your tools. Marked tools are never stolen. No Garage should be without one.



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1200lb per sq. in.

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Ideal for all Hydraulic uses. Cost £100. Our PRICE .. £18/18/-.
3 Stage Hydraulic Pumps, 1200lb pressure, 5 gals. per minute £7/10/-

OFF THE RECORD — NEWS & REVIEWS

There seems to be some special interest lately in the matter of horn loading for loud speakers. Generally speaking this approach is rather too elaborate, costly and bulky for most amplifier fans, but there are a number for whom nothing presents too many difficulties in their search for the ultimate.

By JOHN MOYLE

IT'S not at all easy to answer questions about these things in a way that will be of practical value. It is well within our own powers to build many kinds of amplifiers, and subject them to tests sufficiently elaborate for their performance to be estimated quite accurately.

It is also possible to try out loudspeakers of various shapes and sizes, and to gain a good idea of their relative worth.

But these loudspeaker horns are a different proposition. If you exercise your imagination a little, and picture some of the designs you have seen described as being built up in the flesh, you will realise the amount of work, cost, and space required to gain firsthand knowledge of even a few of them.

This is the dilemma I find facing me when readers write as they do sometimes, asking whether this design would be better than that, or whether so and so's patent scheme would suit a 12-inch speaker better than an eight.

I know quite well that any of these horns will cost the ultimate owner many pounds for material and labor, and unless it happens to bear reasonable resemblance to something I have made or heard, I don't like to take the risk of advising one way or the other.

GENERAL COMMENTS

But it is possible to make a few general comments about loading horns which can be taken as basic, and perhaps to clear up a few ideas which might otherwise confuse the questioner.

I am excluding from these remarks certain better informed people who are able to have built duplicates of speaker horns which they have heard in action, and the performance of which is, therefore, known to them. Not everybody is in this position.

The main function of a loading horn is to provide better development of low frequencies below, shall we say, 100 cycles. The horn is really a matching device which provides a more or less efficient coupling medium between the speaker cone and the air of the room.

A speaker being fed with 50 cycles, for example, and operating with no baffle at all, is perhaps the best example of bad matching between the cone and the air. The cone movement may be quite large, but the audible output virtually nil.

Fitting a baffle to the speaker to increase the air path from back to front of the cone improves the position, and output will increase as the size of the baffle increases.

We can pass then through various other designs all intended to improve the efficiency of the loudspeaker coupling. The best method of all is probably a straight or folded horn, designed so that the area of its internal cross section increases exponentially with each unit of length, and having a total measurement across the mouth large enough to obtain full coupling at 50 cycles.

Such a horn is very large, very heavy, and impractical for all but a large room or a small hall. But it does give a much more efficient result than smaller baffles and enclosures.

FOLDED HORN

Because a straight horn many feet in length just can't be fitted into economical space, various methods are used to fold the horn physically by ingenious arrangements of carpentry. And because it isn't necessary to carry the full development of the horn down to the lowest frequencies to preserve reasonable response, the "cut-off" or theoretical point at which the maximum efficiency is obtained can be set at a somewhat higher frequency to keep dimensions within limits. This "cut-off" isn't nearly as sharp as the term would indicate. Even so, such a device is large and heavy, suitable only for very big rooms.

A disadvantage almost impossible to overcome is that, although folding the horn doesn't seriously prejudice the lower frequencies, it does make it difficult or impossible for the higher frequencies to be radiated from the mouth. Thus we must usually consider such a horn as the low frequency section of a dual or multi-speaker system using other units to fill in the middle and upper end of the spectrum.

NO ESCAPE

Some designs provide horn loading for the output from the rear of the speaker, leaving the front of the cone open for top response. Such designs are really a compromise, and represent an alternative approach to the widely used vented enclosure—perhaps the most convenient compromise of all.

There is no real escape from the size of a good loading horn, as scaling down the dimensions merely moves the cut-off frequency higher up the scale, and gives us reinforcement in a region where it is undesirable without doing the desired job of producing the bottom bass.

One difficulty in considering a true loading horn is that, if we commence with a large 12-inch speaker, the thing becomes more unwieldy than ever. Most horn designs fr overseas are worked out for 6 or inch cones, because there are a nu ber of specially made units of smaller diameter sizes availa there for the purpose.

The 12-inch units as we kn them here are really intended installation in enclosures and ot more modest devices, where it an advantage to start off with large cone area. Some of th speakers go up to 18 inches, but would need to adopt talking p ture technique to use them w calling for horns with enorm mouth areas.

The ordinary 8-inch speak available here can sound quite pressive in a suitable horn, for number of reasons a bit techni for these columns. Although th cone resonances are rather hig than desirable for good bass—t tween 70 and 100 cycles, the "lo of the horn must be taken into c sideration with the physical f tures of the speaker (cone mater mass, suspension, &c.), which termine its resonance. It has effect of reducing the resona frequency and moreover lessen its peak value.

SPECIAL SPEAKER

It is doubtful whether the end sult would justify the trouble a cost when weighed against a sing large speaker of high quality, wh has other worthwhile advantages well.

In other words, you really need special, smallish speaker, preferal with a low resonance, to reap full benefit of your work in bui ing a suitable horn.

Failing this, you will probably wise to modify your ideas, and thi in terms of a solid vented enc sure, perhaps with sand-fill panels or brick construction, bo of which will, according to t figures, do better than all but very heaviest wooden types. It's good doing the job by halves you are interested in horn loadi You stand to be disappointed, a to spend quite a lot of money unsatisfactory results.

RECORD REVIEWS

MOUSSORGSKY. — Scenes fr Boris Godounov and Prince Ig sung by Boris Christoff, with t Royal Opera House Chorus. HM BLP 1003.

There hadn't been a bass in t true Chaliapin tradition until Chr toff came on the scene, and, as was born in 1919, it looks as thou he may yet rival his famous pr decessor. The similarity betwe the methods and results achieved both leaves little doubt as to whe Christoff found his model.

And yet it isn't at all fair to little Christoff for this. Unfortunately Chaliapin was too early for e best quality recording, and comrisons on common ground aren't easy. I doubt whether anyone ll really equal his magnificent cal presence and towering perality which stood out from his rliest discs.

Christoff is much more the modern oduct. His voice is rounder, he as much over the footlights as aliapin was aloof, and I sometnes wonder whether the traditional hnique as exhibited in the Death Boris doesn't come near to an ti-climax these days. There is en precious little between successful heavy drama and lack of nviction. The question is, how se can you get?

At any rate, these are some thoughts ising from recordings which are und to be as popular as others ve been before, and as others will during the reign of this fine ger. There are few bass voices day which can equal him.

OPULAR SUITES

BIZET—L'Arlesienne Suite and CHAIKOVSKY—The Swan Lake ite, played by the Halle Orchestra, nducted by Sir John Barbirolli. MV BLP 1004.

Both have been firm favorites for any years, and these two stock cordings coupled on a single disc ould mean a good seller. I don't ink in either recording or performce they are the best we will hear, t they are good enough. The music too well known to merit special mment.

VIEUXTEMPS—Violin Concerto o. 4, played by Yehudi Menuhin d the Philharmonia Orchestra, nducted by Walter Susskind. HMV LP 1005.

This comparatively short concerto xes up enough romantic appeal d violinistic gymnastics to main- n reasonable popularity, although cannot be grouped with the big ns of the concert platform. In fact, heavy romanticism, like that of ieniawski and Max Bruch, are inned to cloy on close acquaintance, hough Menuhin succeeds in making as appealing as possible, without ipping any of the fireworks deigned to test the soloist's skill.

I should not imagine this to be a cent recording, for, although it is ite a good one, it lacks a degree "bite" possessed by some of the est discs. Once again, it is a od stock recording, which will be rfectly at home on your shelves you like this type of music.

AYDN SYMPHONIES

HAYDN—Symphony No. 47 in G ajor, played by the Vienna Cham- r Orchestra, conducted by Franz tschauer, and Symphony No. 84 E Flat Major, played by the ollegium Musicum of Vienna, conicted by Anton Heiller. Parlo- one-Odeon PMA 1002.

These two symphonies are spaced r enough apart in time to make interesting contrast and comparin in style, for they were separated 15 years and a significant period Haydn's life. They are commendle, too, because the orchestras emselves are obviously no larger an required by the far from heavily den scores.

Neither is a stranger to this type music, and in fact it would be teresting to note how greatly, if at all, their membership overlaps.

From a purely recording point of view, I liked the Chamber Orchestra best, mainly because it uses a much livelier studio than the Collegium.

Its outlines are therefore not so sharp, but it has a rather more pleasant, rounded atmosphere, which the other lacks. At the same time, a dead studio isn't to my mind as objectionable with a small group as with a full orchestra.

I liked them both, particularly the extremely quiet surface which goes for both sides.

MAHLER FOURTH

MAHLER—Symphony No. 4 in G Major, played by the Philharmonic Symphony Orchestra of New York, conducted by Bruna Walter. Columbia 33 CX 1034.

This is probably as good an introduction to Mahler as the uninitiated could desire. It is a good example of his color, his approach to music, and the roads his mind liked best to travel. It is not at all profound in context, and, although there is more in its construction than meets the eye, the over-all impression is of a pastoral ramble in which a variety of tuneful themes are built into a pleasant fabric of ideas.

The orchestration is quite easy to listen to, although no one could accuse Mahler of being mentally concise—on the contrary, he is most reluctant to allow the taste of his invention to die on his tongue. Although he uses a big orchestra, one doesn't get that impression—it is mostly divided into groups balanced against each other, with freely scattered individual playing, in which horns and woodwind are prominent. The mood never solidifies, and in place of a last movement, where one might expect something of the sort, we are introduced to a soprano and one of his early songs. It is, in fact, in the third movement that what weight the symphony has is to be found—a very beautiful movement.

It is not, therefore, strange that Mahler should have been the subject of much violent disagreement in the musical world, which has hailed his genius and condemned his garrulous simplicity. I wouldn't take sides, for the answer is probably between the two.

The recording is a good one, almost without any exceptions. Each in-

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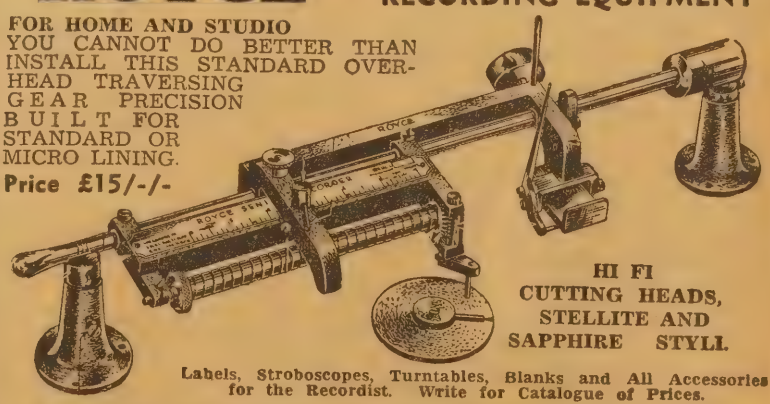

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STANDARD -FERGUSON- RANGE

RECEIVER POWER TRANSFORMERS

CODE NO	PRIMARY VOLTS	HTV aside	HT mA	FILAMENTS
PF185	240	150	30	6.3V/2A
PF299	240	285	40	6.3V/2A, 5V/2A
PF300	240	325	40	6.3V/2A, 5V/2A
PF201	240	225	50	6.3V/2A

NOTE: All transformers are available with upright mounting. The following 9 transformers are also available with flat mtg., fitted with an adaptor plate to suit 3 x 3½in centres. On removal of plate, mtg. centres become 2½ x 3 1-8in. IF flat mtg. is required afix Code No by letter F e.g. PF151F.

PF151	230, 240	285	60	6.3V/2A, 5V/2A
PF166	230, 240	325	60	6.3V/2A, 5V/2A
PF165	230, 240	385	60	6.3V/2A, 5V/2A
PF170	230, 240	285	80	6.3V/2A, 6.3V/2A, 5V/2A
PF169	230, 240	325	80	6.3V/2A, 6.3V/2A, 5V/2A
PF168	230, 240	385	80	6.3V/2A, 6.3V/2A, 5V/2A
PF130	230, 240	285	100	6.3VCT/2A, 6.3V/2A, 5V/2A
PF164	230, 240	325	100	6.3VCT/2A, 6.3V/2A, 5V/2A
PF160	230, 240	385	100	6.3VCT/2.5A, 6.3V/2A, 5V/2A
PF152	230, 240	285	125	6.3VCT/3A, 6.3V/2A, 5V/2A
PF163	230, 240	325	125	6.3VCT/2.5A, 6.3V/2A, 5V/2A
PF181	230, 240	385	125	6.3VCT/3A, 6.3V/3A, 5V/2A
PF174	230, 240	285	150	6.3VCT/2A, 6.3V/2A, 5V/2A
PF142	230, 240	325	150	6.3VCT/2A, 6.3V/2A, 5V/3A
PF175	230, 240	385	150	6.3VCT/2A, 6.3V/2A, 5V/3A
PF167	230, 240	385	150	6.3VCT/2A, 5V/3A, 2.5VCT/5A
PF173	230, 240	425	175	6.3VCT/3A, 6.3V/2A, 5V/3A
PF140	230, 240	385	200	6.3VCT/3A, 6.3V/3A, 5V/3A
PF171	230, 240	385	250	6.3VCT/4A, 6.3V/3A, 5V/3A

POWER AMP. AND LOW POWER T/MITTER UNITS

PF172	230, 240	500	200	6.3V/4A, 6.3V/3A, 5V/3A
PF143	230, 240	600 500	200	2.5V/5A, 2.5V/5A, 5.5V/.5A
PF147	200, 230 240, 260	1000 750 500	200 250 300	5.5V/.3A
PF179	230, 240	475	225	6.3VCT/4A, 6.3V/2A, 5V/3A
PF107	230, 240	585	250	6.3V/3A, 6.3V/2.5A, 5V/3A

C.R.O. TRANSFORMERS

PF188	240	350 one ext. 900	30 2	6.3V/2A, 6.3V/1A 5V tap 4V/2A 4V tap 2.5V/2A
PF545	240	350 one ext. 1000	20 1	6.3V/3A, 6.3V/.6A, 4V tap 2.5/2A

TAPE-RECORDING TRANSFORMERS

PF642	230, 240	250	80	6.3V/3A, 5V/2A Low radiation
PF664	240	265	80	6.3V/3A, 5V/2A Low radiation

PHOTOFLASH TRANSFORMERS

HT119	200	4000 ½ wave	
HT131	240	1100 ½ wave	prim. also vib, 5.2 or 4V

POWER CHOKES

CODE NO	IND HY.	DC RES.	DC MA	CODE NO.	IND HY.	DC RES.	DC MA
CF100	50	1900	10	CF112	10	70	250
CF101	30	870	25	CF113	5/20	70	50/250
CF102	15	300	60	CF115	.017	.6	2A
CF103	30	420	60	CF119	.005	.1	6A
CF104	30	580	80	CF162	10	90	330
CF105	15	250	80	CF196	20	130	125
CF106	12	200	100				
CF107	30	360	100	CF114*	40 watt fluor ballast		
CF108	12	135	150	CF213*	20 watt fluor ballast		
CF109	20	225	150	*Fitted with rubber mounting to reduce hum. Standard 5¼in hole centres.			
CF110	12	100	200				
CF111	16	165	200				

VIBRATOR AND A.C. POWER TRANSFORMERS

CODE NO	PRIMARY VOLTS	HTV aside	HT mA	FILAMENTS
PF182	240AC 12VIB	200	40	12.6/1A
PF122	240AC 6VIB	220	40	6.3V/2A
PF125	240AC 6VIB	250	60	6.3V/2A
PF126	240AC 12VIB	250	60	12.6VCT/1A
PF119	240AC 6VIB	325	125	6.3V/4A
PF146	200, 230, 240 AC 12VIB	325	150	12.6VCT/2.5A

VIBRATOR TRANSFORMERS

CODE NO	PRIM VOLTS	DC Volts	O'put mA	Buffer Full Sec	
VT101	6	90	15	.008	
VT102	6	150	25	.005	
VT103	6	200	50	.005	
VT127	6	200	50	.005	Low radiation. Car Radios
VT104	6	250	60	.005	
VT107	6	250	60	.005	Low radiation. Car Radios
VT106	6	300	75	.008	
VT122	6	400	50	.005	
VT146	12 or 6	240AC	50w	1MFD	For Emergency light, etc.
VT112	12	200	50	.005	
VT132	12	200	60	.005	Low radiation. Car Radios
VT105	12	250	60	.005	
VT117	12	250	60	.005	Low radiation. Car Radios
VT114	12	300	75	.008	
VT123	12	320	125	.005	
VT113	24	200	50	.005	
VT116	24	250	60	.005	
VT115	24	300	75	.008	
VT119	32	150	25	.005	
VT100	32	200	40	.005	
VT124	32	250	60	.005	

FILAMENT TRANSFORMERS

CODE NO	PRIMARY VOLTS	SEC. VOLTS
PF118	220, 240, 260	2.5V/5A, 2.5V/5A
PF158	220, 240, 260	5V/8A
PF476	240	6.3V/3A
PF138	220, 240	6.3V/4A, 5V/4A, 2.5V/4A, 2.5V/4A
PF162	240	6.3V/3A, 6.3V/3A
PF154	200, 230, 240	7V tap 6V/7A, 6.3V/3A, 5VCT/5A 5V/3A, 2.5V/7A
PF102	240	7.5V/2A
PF111	240	10V/5A
PF211	200, 230, 240	10VCT/10A
PF131	230, 240	10VCT/10A, 5V/15A
PF123	240	15, 12, 8, 6V/1.8A
PF439	240	32V 60W Enclosed one outlet
PF457	240	32V 125W Enclosed two outlets
PF491	240	32V 200 W Enclosed two outlets

BATTERY-CHARGING TRANSFORMERS

CODE NO	PRIMARY VOLTS	SEC. VOLTS
PF265	230, 240	17V tap 11.5, 10, 8.5/4.2A
PF389	230, 240	17, 11.5, 10, 8.5V/4.2A, 17, 11.5V/4.2A 17, 11.5V/4.2A
PF537	240	17V tap 11.5V/0.4A

BELL TRANSFORMERS

CODE NO	PRIMARY VOLTS	SEC. VOLTS
PF648	240	10W Continuous or 2A Intermittent.

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IN ADDITION TO THE ABOVE RANGE, A STANDARD RANGE OF OUTPUT AND MODULATION TRANSFORMERS IS AVAILABLE

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mental group is heard cleanly
combines without confusion.
y little in the score would be
in this record. I thought at
es that the touch could have been
ittle lighter, but there is no
bting its sincerity.

he frequency range is good and
balance is better. Surface noise
ow enough to be ignored.

CHUBERT—Quintet in A Major
114 (The Trout), played by
on Kamper, violin; Erich Weiss,
a; Franz Kwarda, cello; Josef
mann, double bass; Paul Badura-
da, piano. Westminster, WL5025.
ike the Death and the Maiden
rtet reviewed last month, the
ut is so named because one of
movements is based on a Schu-
t song so named. But, apart from
ilarities of written technique
ch stamp both works with the
k of one composer, there isn't
reat deal of resemblance in the
od.

PPY MOOD

f the quartet is colored by his
ess and possible premonition of
th, then the quintet is at the
osite end of the emotional scale.
was written considerably earlier
en Schubert was in a much
pier frame of mind, and radiates
piness and joy from the first
e to the last. It does, in fact,
e a cue from the bright, rippling
if of the Trout movement, par-
larly in the piano part.

t isn't a work which should be
mined too closely by students of
struction and form, unless their
rest is mainly in such things as
py key modulations and a feel-
for music put together so rightly
ould scarcely be otherwise. For
t is a secret of Schubert's genius,
natural instinct for color and
v were so true that, with few
eptions, a too formal construction
unnecessary, if not quite out of
ce. It is music to be enjoyed,
ner than analysed. It should
sh over us like a warm sea—
re is little profit in looking for
undotted or t's uncrossed.

ENNA PLAYERS

The players are those of the Vienna
nzerthaus quartet, with the omis-
n of the second violin and the
lition of a double-bass. This, as
jacket tells us, is because the
ginal cello player, one Paumgart-
who commissioned the work,
s a poor cellist, and specified a
uble bass to help him out, as well
the use of the Trout tune.

This, plus the piano, broadens the
sical scope until at times we
en to a small orchestra rather
n a string group. This effect is
ghtened somewhat by a rather
re remote recording than was
rd in the Death and Maiden
rtet, but I don't necessarily offer
s as a criticism. The balance isn't
all bad, although the cello is a
le subdued, possibly after the
mple of the estimable Paum-
tner!

The pianist, I thought, does a most
mmendable job. His technique at
times is clean, his rhythm very
d and he achieves that pianistic
itter" so essential for a good per-
mance.

Altogether, I think you'll find this
thoroughly acceptable record
sically—probably at least as good
you are likely to find at the
moment. Once again I commend all the players for their musicianly approach and freedom from the slightest affectation.

The recording is not breathtakingly wide-range, but it is adequate and clean.

PHILIPS POPS.

Since their Australian record debut some months ago, Philips have made quite an impression on the pop record market. Some of the biggest hits of recent times have been issued here under the Philips label, mainly due to their tie-up with the American Columbia firm for whom they distribute records outside the USA.

There are too many of these records for detailed review, and in any case movement in them is rather swift for a monthly magazine to keep pace.

But you will remember, and you are about to remember, such numbers as the following: Little Josey and Dennis the Menace (B21062H), by Rosemary Clooney and Jimmy Boyd; Dot's Nice—Donna Fight and It's the Same (B21057H) plus I Do, I Do (B20146H) by Rosemary; My Dearest My Darling—Smoking My Sad Cigarette (B21073H, B21024H) by Jo Stafford; Glad Rag Doll by Johnnie Ray (B21031H), Tell Me A Story, I Let Her Go, by Frankie Laine and Jimmy Boyd (B21022H, B21056H); and Kaw Liga by Champ Butler (B21016H).

In addition to these there are records by a big collection of names including Doris Day, Percy Faith and Orchestra, Wally Stott and Orchestra, The Four Lads, Hotcha Trio (Harmonicas), Tony Bennett, Felicia Sanders, Sarah Vaughan, Red Buttons, Lu Ann Simms, Sammy Kaye, Geraldo, Guy Mitchell and Mindy Carson, Pete Hanley, Errol Garner, Sammy Kaye and Art Lowry. The list is being added to all the time.

In the microgroove field, the Benny Goodman records made in Carnegie Hall have been immensely popular. They are followed by one from the Dutch Swing College Band —Gems of Jazz, played in the New Orleans style. (P10008R).

Philips have certainly opened the popular firing line with a bang.

THE R&H "RAMBLER" PORTABLE

(Continued from page 37.)

both the high and low tension battery circuits.

The battery leads (four in all) are taken through a hole in the left front of the chassis and should be protected by means of a small rubber grommet.

The audio leads pass through a hole near the gang cut-out and should be of the shielded variety to avoid unwanted audio coupling to other parts of the circuit. The cover of the pot should be connected to the shielding, which should also be earthed to a chassis lug at the other end.

AUDIO LAYOUT

Contrary to what might be imagined, the layout of the audio section is quite important, it being all too easy to provide unwanted plate to grid coupling with attendant audio feedback. The main requirement is to keep the plate and grid leads of the 1S5 well separated and the layout has been arranged with this in mind.

This locates the grid coupling capacitor (C16) alongside R7 on the tag mounting strip and well away from the plate circuit components C19, R10, C17, &c., which are mounted against the side of the chassis. It is also important to keep the leads to the speaker as short as possible and well away from the early audio stages. The final test for audio stability should be made with the speaker in position and at all settings of the volume control.

However, before making this test it is important to check the filament circuit very carefully to make sure that it is not mixed up in any way with the HT supply and that the series connections are correct. First, plug in all the valves and connect the nine-volt battery only, checking the filament voltage applied to each valve. This should be about 1.5 for each except the 3V4 which should be three volts. These figures will drop slightly after the battery has been in use a short while.

If all appears well remove the valves and connect the HT batteries as well. Now measure the voltage across the entire filament network and make sure it does not vary from the original nine volts. If there is any variation when the HT batteries are added it may be that there is a fault which could damage the valves and the circuit should be thoroughly checked.

If this test is passed the valves may be plugged in again and the set switched on. Some signs of life should be heard immediately and the stronger stations should be audible. It only remains now to align the set to achieve full performance.

The alignment procedure has been described many times and a pamphlet covering it is available through the query service. The only unusual feature about this set is the absence of any oscillator circuit adjustment at the low frequency end of the band. However, assuming that the padder value is correct, the oscillator coil the correct inductance, and the IF channel adjusted to the correct frequency, the dial should track correctly with the stations. Slight errors are corrected by shifting the dial on the gang shaft.

ADJUSTABLE CORES

Correct tracking is assured because the RF and aerial circuits are both adjustable at the high and low frequency end of the band. The final adjustment of the aerial trimmer and the loading coil should be made with the loop mounted in its final position.

And that is about all there is to tell, so if you want a portable which will give a really good account of itself we suggest you obtain a kit of parts and make yourself a "Rambler". We feel sure you'll vote it a first-class set.

SHORT-WAVE NOTES BY ART CUSHEN

GOOD SIGNALS FROM CANADA

Radio Canada, the International Service of the Canadian Broadcasting Corporation, is providing excellent reception in the Australian Service.

NOW in its 8th year of operation, the International Service of the Canadian Broadcasting Corporation is providing listeners in the South Pacific area with excellent reception and a bright, varied program in the twice-weekly transmission broadcast in this direction.

The Radio Canada transmitters are located at Sackville, New Brunswick, on the eastern coast of Canada, and are fed from the studios in Montreal by a landline of over 600 miles. The short-wave transmitters, which are two 50Kw, together with several high gain beam antenna, slung from a mast which will stand winds of up to 120 mph, cost the CBC some £400,000. The beams can be slewed up to 13 degrees, plus or minus, of the main direction of the beam, thus giving some flexibility in the direction programs can be broadcast.

The CBC operate services directed to Europe, South America, Australasia, and the North-West Territories, while a service for the Canadian troops is broadcast daily for reception in Australia, for later rebroadcasting by Radio Australia, to Korea.

LATEST SCHEDULE

The present CBC schedule is as follows:—

NORTH WEST TERRITORIES (daily), 2.40-3.20 pm, CKLP (9585), CKRZ (6060).

AUSTRALASIA (Wednesday, Sunday), 6.45-7.50 pm, CKLO (9630), CKNA (5970).

TO FORCES IN KOREA (daily), 6.25-6.45 pm, CKLO (9630), CKNA (5970).

TO EUROPE (daily), 10.20 pm-9.30 am, over the following transmitters: CKNC (17,820), 10.20 pm-4.45 am; CKLX (15,090), 10.20 pm-12.05 am; CKCX (15,190), 12.05-2.30 am; CKCS (15,320), 2.30-6.45 am; CHOL (11,720), 5.00-9.30 am; CKLP (9585) 7.00-9.30 am.

TO LATIN AMERICA-CARIBBEAN (daily), 9.50 am-2.00 pm, CHOL (11,720); CKLO (9630).

Reports are appreciated by the International Service, and are verified with an attractive verification card. Listeners will find the CBC program booklet also of interest, and this is also supplied to listeners. Reports should be sent to Radio Canada, PO Box 6000, Montreal, Canada.

G.O.S. TOPS POLL

The BBC's General Overseas Service was placed at the top of the popularity poll which was recently organised by the International Short Wave Club of London. Short-wave listeners submitted a list of their favorite short-wave stations, and the reasons why they were so popular. As in the 1950 poll, listeners in all parts of the world cast over 5000 votes for the stations they found most popular. The place-getters, together with the number of votes polled, were: — BBC Overseas Service (847), Radio Australia (751), Swiss Short Wave Service (615), Belgian Short Wave Service (531), Radio Canada (471), Radio Nederlands (417), Radio Ceylon (318), Brazzaville (245), Radio Ankara (233), Radio Pakistan (151), Armed Forces Radio Service (151), Voice of America (149), Radio Argentina (144), Radio Andorra (140), Radio Sweden (135), Radio Indonesia (121), while 24 other stations polled under 100 votes. Congratulations must go to the BBC for commanding top place, and to Radio Australia, which maintained the second position, a place it also held in the 1950 census. The 1950 winner, Radio Belgium, dropped to 4th place, this being due to the poor reception now being experienced by listeners in Europe since the facilities were moved from Leopoldville, Belgian Congo, to Wayree, in Belgium. It will be seen that stations which specialise in more propaganda type of broadcasts found little response from listeners, the most noted being the Voice of America, which dropped from 7th to 16th in the latest poll, while Radio Moscow this time had not one vote cast in favor of its broadcasts.

NOTES for the next issue close at 212 Earn Street, Invercargill, New Zealand on October 11. All times are Eastern Australian Time.

JAPAN USES 11,780Kc

Radio Japan, in the new schedule which came into effect on September 1st, has been using 11,780Kc, a frequency which for some years has been used by Radio New Zealand. The Tokio transmitter uses the frequency when it is being used by Wellington, 3.00-4.00 pm, which will result in poor reception of either transmission in the North Pacific area. Tokio also uses another new frequency, as regards overseas broadcasts. This is 9695Kc, which has been only used to date for the Home Service rebroadcasts. Japan now has 10 overseas transmissions, and had added Indonesia, Spanish and Portuguese languages, reports Radio Australia.

The new schedule is as follows:—

Transmission 1 (to USA), 3.00-4.00 pm on:—JOA3 (9695), JOB4 (11,780); 2 (to Hawaii), 5.00-6.00 pm on JOA6 (15,135), JOB4 (11,780); 3 (to Australia), 7.00-8.00 pm, JOA6 (15,135), JOB6 (11,725); 4-5 (China), 9.00-11.00 pm, JOA3 (9695), JOB2 (7180); 6 (Philippines), 11.30 pm-12.30 am, JOA3 (9695), JOB6 (11,725); 7 (Indo-China-Thailand), 12.45-1.45 am, J (9695), JOB6 (11,725); 8 (India-Pakis 2.00-3.00 am, JOA3 (9695), JOB6 (11, 9 (Europe), 5.00-6.00 am, JOA3 (9 JOB2 (7180); 10 (South America), 8.00 am, JOA6 (15,135), JOB6 (11,725)

LISTEN FOR THESE DX STATIONS

Kcs.	Call and Location	Times Heard (AEST)
3975	BBC, London.	2.45-3.15pm, 4.30-8.00am.
4960	YDB2, Djakarta, Indonesia.	8.30-10.45am, 7.30pm-1.30am.
5030	Dakar, Senegal.	Sign off 6.15am.
7240	Paris, France.	English 4.45-5.00pm.
9515	KRCA Los Angeles.	UN broadcasts 3.00pm.
9735	GWF, London, England.	6.00-6.45pm.
11725	JOB6, Tokio, Japan.	7.00-8.00pm.
11970	Paris, France.	English 4.45-5.00am.
11980	CE1198, Santiago, Chile.	Closes 2.00pm.
15375	London, England.	9.00-9.30pm.

FLASHES FROM EVERYWHERE

RADIO NEW ZEALAND'S sche which became effective on Sep ber 11th, includes a frequency ch for Australia, which due to the us the frequency by another station schedule due to operate from Sep ber 5th was altered. Radio New Ze now operates:— To Australia, 4.00 7.45 am, ZL8(9620); 8.00 am-4.45 ZL9 (11,810); 5.00 pm-close down, (9620).

To Pacific Islands, 4.00 am-7.45 ZL18 (9520); 8.00 am-4.45 pm, ZL3 (11 5.00 pm-close down, ZL18 (9520). down is at 8.45 pm weekdays, 9.2 Saturdays, 8.00 pm Sundays.

BBC 4Mc transmitter is now oper on 3795 Kc, 2.45-3.15 pm, 4.30-8.00 am, 9.15 am. Due to the coming wint England, frequencies for transmis to Europe are to be at a new low r The best usable frequency will round 4Mc, the BBC are testing on new channel. This is the first of se frequencies to be put into service 4Mc, and new aerials are being er for use on this band. The present b casts are mainly to a test schedule are keeping the frequency "warm" such time as the band is bro into full operation. During this ing winter in Europe, the use of band for European reception will b best for coverage, and other cou may be using nearby frequencies. BBC transmitter is using 50Kw simple dipole antenna.

The Pacific service will be retime 6.00-6.45 pm on September 27, and BBC transmitters directed to this will then be GSW (7230), MCP (MCR (9760) and GVY (11,955). The sign MCP is to be replaced by Several new BBC frequencies have noted in the General Overseas Ser 15,420Kc broadcasts 7.00-7.30 pm, 15,4 7.30-9.15 pm, 17,740Kc 11.15-1.30 15.375Kc, 9.00-9.30 pm.

RADIO FRANCE ASIE'S transmi to Australia and New Zealand has extended and now opens at 6.45 pm, ing at 8.15 pm. The station uses 15,4 and provides a very good signal to area. Saigon's new English Depart Head, Mr. H. E. Dufor, advises tha will be only with Radio France As December, when he returns to Fr He is very anxious for reports and gestions about the program, which be sent to him at PO Box 412, Sa Vietnam (Indo-China).

UNITED NATIONS RADIO is well received in the Transpacific vice from sign on at 3.00 pm. Freq cies used are KRCA, 15,270, 11,755, 95 and Honolulu 17,800, 15,330Kc. The vice is repeated at 5.15 pm over Manila transmitters using 17,780, 1 11,895 Kc, English news being prese at 5.15 pm.

GREECE'S ARMED FORCES RA STATION operating on 7426Kc, is broadcast on a new schedule, 2.30-6.00 10.00 pm-midnight, 3.30-9.00 am. Re tion is fairly good both at 5.00 pm again at sign off at 8.00 am. Other f stations in Greece operate from Cav Jannina, Larissa and Salonika.

RADIO ITALIANA'S short-wave br casts, which can be heard in this include the improved evening trans sion. Details on the broadcasts Rome have been requested by Mr Greco, Fairfield, NSW. The Far Eas service broadcast 7.45-10.15 pm on 1 15,400 and 11,900Kc. The North Am can service is also received to sign at 1.00 pm, with news in English in last 15 minutes of the transmission. reception on 15,400, 9710 and 9570Kc,

THE HAM BANDS WITH BILL MOORE

ROUP FREQUENCY ALLOCATION IN THE VHF BANDS

With the influx of more stations on the VHF bands it has been found necessary to arrange group frequency allocations. These arrangements should lessen the problems of interference, and will allow the most effective use of these bands.

ND Planning, the division of amateur ands into segments by regulation, or voluntary basis, is a common arrange- on the lower frequency bands. Such ons are generally made to separate raphic, telephonic, emergency or ar working, and is not a usual ad- to VHF operating.

planned arrangement for the 144 and bands, however, has been intro- on a voluntary basis in the British British amateurs have no 50Mc band. nain activity on the VHF's is centred e 144Mc band.

tion population on this band is quite and to provide better chances of nt contacts, and to minimise inter- ce, the British Isles has been divided zones for operation.

h zone has been allocated a segment e band. Here in Australia, with not any stations operating, no such gen- arrangement has been considered but encies have been set aside for ry stations.

CIAL MEETING

pecial meeting to discuss the subject convened by the Technical Commit- f the Radio Society of Great Britain, sentatives of Wireless World, Short- Magazine, The Radio Amateur, dele- from The Television Society. The h Amateur Television Club, the on UHF group and RSGB. The dent, Leslie Cooper, also attended er considerable discussion, it was imously decided to divide the 144Mc as follows: The frequencies 144 to Mc were set aside for Scottish sta- 145.8 to 146Mc for Irish stations; England was divided into seven . Depending on population, the lat- ere allotted segments from 150 to in width.

e publicity to the plan will be given ghout Europe by the publications ocieties represented, and it is hoped amateurs will voluntarily adopt the ne after the initial problems of als and beams are resolved. The 3 will reproduce a map showing the and allocations arranged.

specific geographical arrangement decided upon for the whole 420-460Mc but because the section 432 to 438Mc harmonic relationship with the band, it was decided that operation is segment should be in accord with zonal arrangements for the latter

s segment was set aside for the use tions employing frequency stabilised missions either telephony or tele- y.

er divisions were as follows: 420 5Mc—self-excited oscillator emissions. to 432Mc—amateur television. to 445Mc—amateur television. to 455Mc — future amateur radio opment.

to 460Mc — self-excited oscillator ions.

s hoped that the planning will make tion on these bands more congenial effective, and allow the maximum cts when extended ground wave s reach out over normal distances.

ENT CONTEST

Remembrance Day contest run in August was as usual very well sup- d, and hundreds of amateur stations ghout the Commonwealth and Ter- es joined in to decide the destina- of the RD trophy for the ensuing

ring was again high, some scores of 700 points being reported, and quite nber of scores over 600 points.

It was interesting to follow the operating technique of some of the leading competitors Some were satisfied to contact stations providing 2 and 3 points and build up their score by making a large number of contacts. Others preferred to wait for stations providing 5 and 6 points, keeping the number of contacts down, but the average point score per contact up.

Stations using either of these methods recorded scores in the region of 700 points and it appears that to some degree it depends on the State location which method provides the best tally.

A number of VK2's and VK3's, for instance, built up good scores by concentrating on VK4's, VK5's and VK7's for either 2, 3 or 4 points.

Perhaps, from an operating viewpoint, the most interesting aspect, was the general trend toward fuller use of telephony, and there appeared to be a considerable curtailment of CW activity. Some CW participants complained of the dearth of stations on the key.

Propagation conditions generally were not very favorable, and interference and static caused a good deal of inconvenience to competitors.

In Eastern Australia 3.5Mc seemed to provide the best operating conditions, 7Mc and 14Mc bands were fair, while 21Mc supplied only W's and ZL's at this location.

Undoubtedly Test cricket made some impact on activity on the Saturday evening. There was quite a deal of operating when stumps were drawn.

On the Sunday evening and the few evenings just following the contest, it was instructive to follow the varied reactions of amateurs to the Test.

A number of good suggestions were heard on variations of rules for future contests. It is a pity that the comments could not be forwarded to the Federal Contest Committee for perusal, as some of the ideas appeared as if they would receive general support.

Most comment centred around the continuous operating period of 24 hours. Some amateurs suggested a break from midnight to a reasonable hour on Sunday morning, others thought times in line with the NZART's Memorial Contest —two periods Saturday and Sunday evenings—would be suitable.

In lighter vein was a suggestion that a special certificate be awarded to all stations scoring over 600 points in view of their marathon operating effort—it was considered they deserved one.

The NSW division of the WIA intend to submit to the Federal Executive that a suitable period be set aside when operation ceases—a silent tribute to the amateurs who made the supreme sacrifice.

It was also considered that possibly a special broadcast could be made during this period.

THE TVI PROBLEM

The ARRL is proceeding with its extensive educational program on TVI and its problems. Well-known authority on the subject, Phillip Rand, WIDBM, Technical consultant to the League, has been barnstorming the country lecturing on and demonstrating TVI.

Special attention is being paid to areas where lower frequency VHF channels are in use, and TVI is most troublesome.

The equipment in use has been specially installed in a station wagon, and the aim of the service is primarily to acquaint servicemen and dealers with information on TVI—its cause and prevention.

By means of slides they are shown how to determine from the picture pattern, the probable source of interference. The demonstration equipment was designed and built by the ARRL technical department.

Besides these demonstrations the ARRL supplies to TVI committees and clubs much technical data. This covers various forms of TVI, ideas on suitable publicity to combat irresponsible Press references on TVI (amateurs in any given area are blamed for practically all TVI), data sheets for TV listeners to assist them in identifying the form of TVI present, besides TVI information on 16mm film.

Local TVI committees are, too, doing much valuable work, both in eliminating TVI and educating the public on the subject. Valuable liaison is provided between amateurs and sales and service managers of TV manufacturers.

WIRELESS INSTITUTE ACTIVITIES

Amateurs, short-wave listeners and intending amateurs, who are desirous of joining the Wireless Institute of Australia, can contact the secretaries of the various divisions at the listed addresses.

WIA members enjoy many privileges, lectures, QSL service, &c., and the institute needs the support of all persons interested in the hobby.

Divisional addresses:—

New South Wales: Box 1734, GPO, Sydney.

Victoria: Law Court Chambers, 191 Queen St., Melbourne.

Queensland: Box 638J, GPO, Brisbane.

South Australia: Box 1234K, GPO, Adelaide.

Western Australia: Box N1002, GPO, Perth.

Tasmania: Box 371B, GPO, Hobart.

The current frequency bands available to amateurs in Australia are as follows: All changes in accordance with Atlantic City ITU frequency allocations have been adjusted.

1.84 to 1.86Mc, 3.5 to 3.8Mc, 7 to 7.15Mc, 14 to 14.35Mc, 21 to 21.45Mc, 26.96 to 27.23Mc, 28 to 30Mc, 50 to 54Mc, 144 to 148Mc, 288 to 296Mc, 570 to 585Mc, 1215 to 1300Mc, 2300 to 2450Mc, 5650 to 5850Mc, 10,000 to 10,500Mc, 21,000 to 22,000Mc, 30,000 and above.

The band 1.84 to 1.86Mc is available for emergency network purposes only.

While 288 to 296, 576 to 585, 21,000 to 22,000 and 30,000Mc and above are temporary allocations.

The NSW UHF section meeting was held on September 4 when the third and final of a series of group discussions was presented on portable and mobile operation. The subject this time was on suitable power supplies for such work, and was introduced by Harry Solomons, VK2AJZ.

NSW UHF VK2WI broadcasts, are held weekly at 1930 hrs. EAST on 144 and 50Mc, not at 2000 hrs. as previously mentioned

The August UHF Field Day concluded at North Richmond when the "mobile" hidden transmitter was finally positioned. The equipment was operated by John Miller, VK2ANF, and Es Griffiths. First to locate the transmitter was Harry Solomons, VK2AJZ; second, John Peell, VK2WJ. 11 cars participated. The section runs monthly field days to encourage mobile operation among members

English amateurs extended their 144Mc

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.1	400	1/-
.1	600	1/3
.25	400	1/3
.35	200	1/2
.35	400	1/3
.5	200	1/3
.5	400	1/6

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19	20	3d	4d	4d
22	23	2d	2d	2d
24	25	1d	1d	1d
26	27	1d	1d	1d
27	29	1d	1d	1d
28	30	1d	1d	1d
29	31	1d	1d	1d
30	33	1d	1d	1d

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1¼ inch	5d
1½ inch	5d
2 inch	7d
2½ inch	8d
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d in July when many stations con-
d LA8RB during a good opening, the
nce, 700 miles. G6NB was the first
n to make the contact. During the
period the first GW/PA contact was
lished on 420Mc.
/2ADZ and PAONL worked over a
nce of approximately 300 miles.
turer at the August meeting of the
was Mr. Leo Medina, of the CSIRO,
ubject, "Some aspects of the design
mall transformers." As in previous
res given by Mr Medina he present-
number of original ideas and judging
the copious notes taken the lecture
well received.
e lecture was recorded on tape for
lation among country groups and
follow the tape on BCI at present
lating in the south-western zone.
tober and November will see much
ity in NSW in the field and at con-
ons.
ree events will take place on the Six
Day weekend, October 3, 4 and 5.
e first of these is the NSW UHF
on's Field Day conducted on 144Mc.
ons will be in the field and operating
le out from Sydney. Some of the
d will be spent travelling. Amateurs
will be operating from home on the
lay are requested to listen out for
ons in the field on 144Mc.
e second event on the same week-
is the western zone's convention to
eld over the three days at Forbes.
extensive program has been arranged
ntertain zone members and visitors.
ne officer, Hugo Stitt, VK2WH, and
Meagher, VK2AMV, are in charge
he organisation and inquiries should
directed toward these amateurs.
wcastle will be the venue for the
l event The Hunter Branch will con-
on the Saturday evening a nocturnal
en transmitter search, a change from
normal run of such events. The Sun-
will be taken up with a picnic when
special features for the XYLs and kid-
dies will be conducted.
The next event, the South-Western
Convention, will be run at Wagga on
October 31 and November 1. Alf Moye,
VK2BW, and Stan Mitchell, VK2AID, are
organising the Wagga end. Zone officer
Jim Edge, VK2AJO, would be pleased to
hear from any amateurs likely to attend
November 15 has been selected as the
date for the NSW Division's Annual Woy
Woy Field Day. Attendance during the
last three years has exceeded 200, and
this year's field day should be just as
popular as an excellent program has been
arranged.
Assembly as usual will be at 10.30 am.
at the Woy Woy Masonic Hall. Cec Hard-
man, VK2KR, will be in charge of local
arrangements. Make a note of the date.
The Hunter branch will hold their
Xmas Party on December 12, another date
to remember
Full details of all these events will be
given over VK2WI in the 1100 hrs. broad-
casts on Sundays, and in Amateur Radio.
For amateurs who (like myself) missed
out on the CEQ contact in August, there
is still some hope. From the accumulation
of dollars in excess of QSL expenses, it is
planned to set up a permanent station
on Easter Island. W stations who con-
tacted CEQAA are each contributing one
dollar to cover expenses of QSL's. It is
only hoped they contacted sufficient
American stations to build up a respect-
able surplus. If the number of W's heard
calling was any indication, there is some
possibility. Easter Island is some 2000
miles west of Chile, is 50 square miles
in area and the population 300 persons,
plus much weird carving.
The 20-metre band shows some im-
provement in the late afternoon and
evenings. On odd nights quite a number
of Asian stations are at good strength
from 2000 hours onward. Next month
should see the return of some Europeans
around 2200 hours EAST.

HAMS! WHAT ABOUT YOUR SONS?

The romance and excitement associated with shortwave operation in the 1920s and 30s, to large degree, is lacking and world communication is a clear-cut process in our amateur bands these days. The shortwave listeners' ranks have slowly depleted and as most amateurs graduated from the role of SWL, perhaps these factors are affecting the population question.

Cost of equipment could be a contributing factor. Prewar one could instal a fairly effective station for £30 to £40. Today this amount would about cover the cost of a respectable home-built communications receiver, not to mention the many pounds to be spent on all the other equipment.

Simple equipment can be built, but it could not be expected to suffice for long, in view of the crowded condition of our bands. Counter-attractions are more varied and the growing need for better educational qualifications for many positions also must reflect.

Without a doubt, amateur radio is a hobby that provides great enjoyment, considerable education and a compass of friends in all walks of life. To follow it closely, to keep reasonably well acquainted with the latest in technical development, make such demands on our time and, for that matter, on our pockets, that only the more fortunate few can run the distance.

How many of us encourage our sons to follow in the game? Not very many. To be honest, we see the many problems, social and otherwise, that can arise from a too earnest following of the varied phases of amateur radio. For that matter, quite a number of sons are quite vocal on father's hobby.

In the US the amateur licence totals as opposed to other countries are still rising. This is due in a large degree to the introduction of the classes of licences novice and technical, with the decreased examination requirements.

Getting back to one of the first observations, this is our first experience of a sun-spot minimum affecting our HF bands as we now know them. Possibly, when conditions do improve again, we may see some of the tremendous enthusiasm displayed in 1947 and 1948.

NEW PORTABLE P.A. SYSTEM

(Continued from Page 77)

lote that certain measurements
l be dependent upon the thickness
the wood used. The usual thick-
s is 3/8in plywood.
he join of the front with the
and bottom can be backed with
iece of quad mould so that the
and bottom edges can be round-
off to enhance the appearance.
ually, all edges of the speaker
e should be rounded off some-
at to reduce the chance of the
ering wearing through too quick-
at these points.
he shelf in the amplifier and
ver supply rack has a cut-out in
centre to allow the speaker mag-
to recess. This allows a saving
the overall width of the case.
rear face of the amplifier chas-
is also cut out for this purpose.
e cut-out is centrally placed with
adius of 1 9-16in from a centre
nt 1in below the bottom edge
the chassis. The ready-made
ssis will already have this cut-out.

UIDANCE

or those who would like a little
dance in construction of small
inets, we would refer them to
ge 36 of the November, 1952,
ue, wherein the detailed descrip-
n is given of the construction of
cabinet for a baby mantel re-
ver.
Similarly, on the matter of covering
carrying case and rack with
therette, we could do no better
n refer you to the article which
peared on page 37 of the Decem-
, 1952 issue dealing with the cov-
ng of the cabinet for the Holiday

The speaker grille material is glued in position at a number of spots.
The speaker is screwed to a piece of 3-ply with an appropriate cut-out and which in turn is screwed to the inside of the case front. See that the screws do not protrude through the front of the case.

LEAD STOWAGE

The wooden blocks acting as stops for the rack will provide sufficient anchorage for four suitable size cup-hooks, screwed in near the corners at the top and bottom. These hooks hold the speaker lead in place when it is wound up into the case.

The photographs show how the accessory leads are stored in the speaker case and how the units fit into the rack. In most cases, the microphone head will also fit into the space around the speaker. The microphone stand will obviously have to be carried separately.

We feel that when you have finished this project you will have a PA system which can be put to many uses and something of which you can be proud.

If you desire press-to-talk facility on battery operation, it can be arranged by wiring the press-to-talk switch in series with the lead from position three of switch section S1a to pin three of the vibrator socket. Entry to this wiring can be made through a pair of terminals or another miniature plug and socket on the supply chassis. When not required, the terminals can be bridged or, if using a plug and socket, the bridging can be done with a dummy plug.

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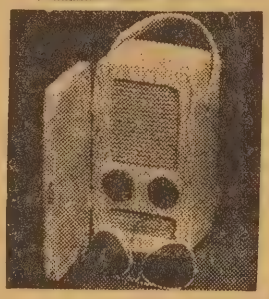
5 Valves, with R.F. stage and 7in Speaker. In suit case style cabinet — a really high grade set.



CARRY-SET

4 Valve personal portable in smartly styled cabinet. Small, highly efficient—quite outstanding in personals.

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- 32-Volt Receiver
- Senior Radiogram.
- Vibragram 7
- Simple Superhet
- Advance 1951 & 1952
- Fidelity 5
- Babygram, etc., etc, etc.

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Yes, we can supply kits for the complete R & H range of Playmaster amplifiers, control units, tuners, and pre-amplifiers. These are also available ready built. Also available is our own 25 watt P.A. amplifier, kit or ready built.

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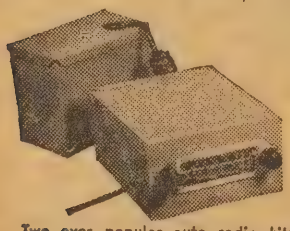
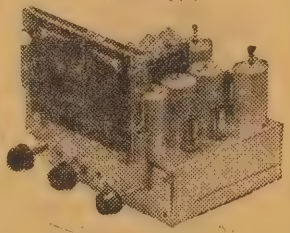


Two ever popular auto radio kits, the "R & H" 5 Valve Kar-Set at left, and 4 valve Kar-Set at right. Easy to build, good to look at—marvellous performance.



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A HOME-MADE EXPOSURE METER

An electric exposure meter is a device which many amateurs would like to own but regard as out of the range of their pocket. This article, contributed by a reader, describes how one can be built around a disposals meter at a very low cost. Carefully made, it should perform quite as well as a commercial instrument.

By H. C. BELL

THE two main items are a photo-electric cell of the selenium barrier type and a sensitive micro-ammeter. The cell is a Megatron type A, measuring 22mm by 40mm. These have one connection to the metal back of the cell and the other via a thin metallic strip deposited on the front of the cell near the edge. They are normally mounted by clamping between two metal plates, one having an opening to permit the light to reach the front of the cell.

CELLS AVAILABLE

The original cell was obtained direct from the makers in England but these are now readily available in Australia. (The Australian agents are Paton Electric Pty. Ltd., 90 Victoria Rd., Ashfield.)

The microammeter was one taken from an aircraft "Landing Indicator" unit, and was obtained from a disposals store. This unit contains two nearly identical meter movements, carrying from 50-100 microamps full scale deflection and are just about ideal for the job in hand.

There are several types of indicator unit available but the type most suitable for the purpose is one with the crossed pointers. Apart from its higher sensitivity, the fixing in its original case lends itself admirably for use in a metal box.

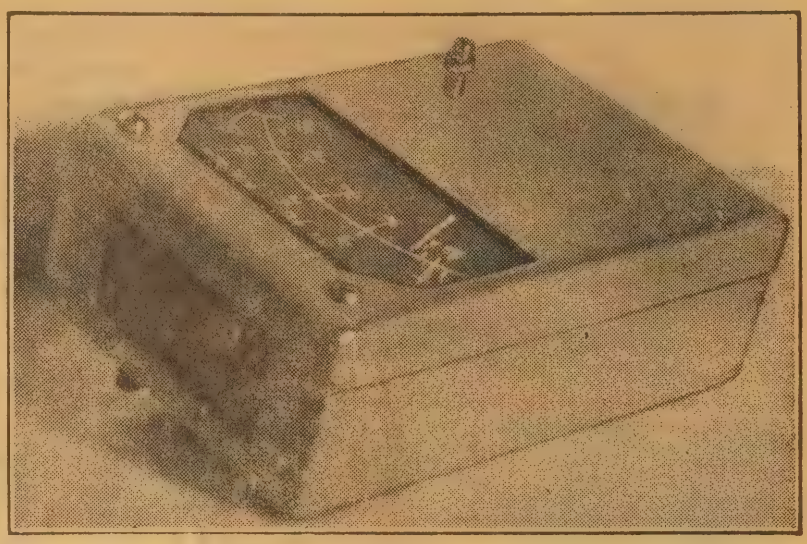
There is another point which should be mentioned, namely that in some types of unit, the magnet is at right angles to the pointer, while in others it is in the same plane. Should the constructor obtain one in the former position, it is quite a simple matter to loosen the two screws which hold the pole pieces in position and twist the magnet through 90 degrees and retighten the screws again.

Care should be taken not to damage the pointer in the process, as the instruments are very delicate. The method of fixing the meter movement in the case can be left to the constructor's discretion. The material used for the case is not very important.

CASE MATERIAL

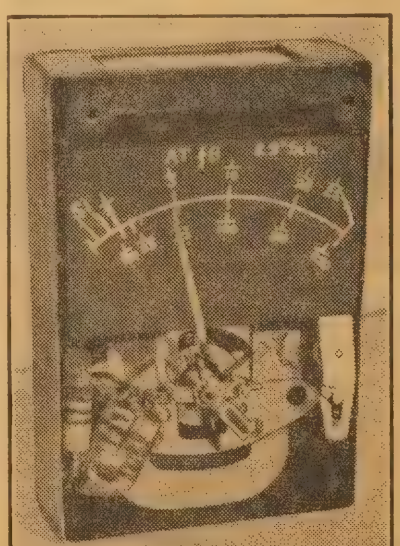
In the writer's case 24g tinned sheet iron was used, although there is no reason why brass should not serve just as well. In fact, a brass case can be made somewhat smaller, due to the fact that when using tinned iron the magnet must not be placed nearer than 3-8in to any part of the case. An iron or steel case can act as a magnetic shunt and thereby decrease the sensitivity of the finished meter.

The case for the original was 3½in x 2¾in x 1½in, but this can be reduced to about 2½in x 2in x 1in if brass is used.



A view of the completed meter. The cell is about ⅜in behind the opening in the top of the case, the shield serving to restrict the angle of light pickup. Note the sensitivity button near the far edge of the case.

Incidentally, if there is already a magnetic shunt across the magnet tips on the meter it should be removed, so as to obtain the highest sensitivity.



An interior view of the meter. The meter movement can be clearly seen and the shunt and series resistors are on the left. The sensitivity switch is on the right. The edge of the cell is just above the meter scale.

The meter described has one range from 1/20sec-1/250sec and by means of series and parallel resistances the range is increased to 5sec-1/25sec. The scale is calibrated for 29 degrees Sch. film when using an aperture of f8. This makes conversion easy when using different film speeds and apertures.

The full diagram of connections is shown, but a brief description of the calculation for the series and parallel resistors may be necessary.

Due to the cell working into a given load, i.e. the resistance of the meter movement, the same load must be imposed on the cell when working on the alternative range. This means that the range cannot be extended simply by means of a series resistance but that a shunt resistance must also be added, to bring the total load across the cell back to its original value.

SWITCH ACTION

As will be seen from the circuit the series and shunt resistors are normally connected, but on depressing the switch, the series resistor is short-circuited and the shunt resistor is open circuited, and only the meter is connected across the cell to give maximum sensitivity. It will be seen that any variation in the resistance of the meter movement will mean a different value of both resistors used.

The cell chosen for our purpose was 22 mm x 40 mm and a ratio of 10-1 was selected for the alternative range, which made the marking of the scale easier, due to points on both ranges coinciding on the

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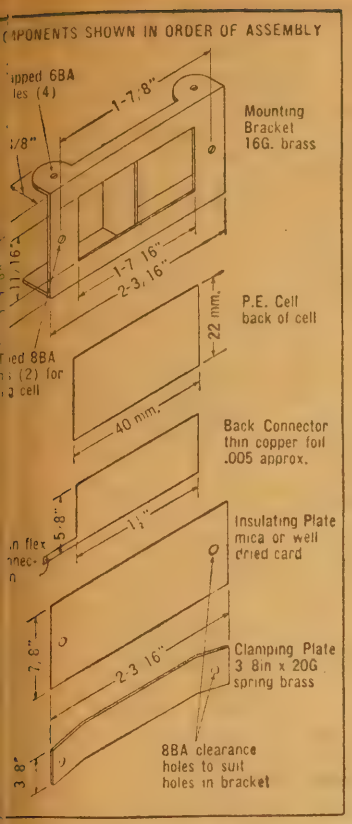
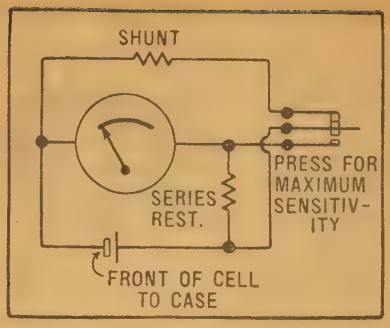

COMPONENTS SHOWN IN ORDER OF ASSEMBLY
Mounting Bracket 16G. brass
P.E. Cell back of cell
Back Connector thin copper foil .005 approx.
Insulating Plate mica or well dried card
Clamping Plate 3 8in x 20G spring brass
8BA clearance holes to suit holes in bracket
40 mm.
22 mm.

e component parts of the cell ounting, shown in the order of sembly. The bracket at the top is signed to restrict the angle of light ckup to that of the average camera.

e. For this cell a ratio of 10-1 candles means a ratio of current rom 40-250 microamps approx, ch is 6.3-1. This means that series resistor has to be 5.3 s the value of the meter move- it.

s an example, in the case of the rument described, the meter re- ance was 400 ohms (the lower better) and this gives a series stor value of 2100 ohms. A ple calculation shows that the l resistance across the cell is

typical disposals meter of the type uitable for conversion to the exposure eter. This instrument has two meter ovements, one being linear and the ther tapered. However, both could robably be used provided the scales are calibrated accordingly.



The circuit of the meter showing the arrangement of the sensitivity switch and the shunt and series resistors. The values of the resistors may have to be modified to suit individual meters.

now 2500 ohms and therefore a 476 ohms shunt resistor must be added in parallel to bring the total load back to 400 ohms.

The switch for increasing the range was made from parts of an old post office telephone jack. A visit to the surplus stores will no doubt result in obtaining one quite cheaply.

An important point about the mechanism is that it must maintain electrical isolation between the circuits under test and the metal panel. The push button can either be a metal screw passing through an insulating bush or it can be a captive bobbin shaped from bakelite or similar material.

It should just rest on the spring leaf and return to its original position when the thumb is removed.

The plate which is fixed to the front of the cell mounting bracket may need a little explanation. The purpose of this is to restrict the angle of light pick up to approximately that of the camera and is just a piece of thin sheet brass soldered on the bracket by its edges.

All front surfaces of the bracket and the baffle plate, and also the inside of the case, adjacent to the front window, should be painted with photographic matt black. The cell mounting bracket is secured to the inside of the case by two 6BA screws on approximately the same centre as those in the top.

It only remains now to calibrate the meter. For this purpose an obliging friend came to the rescue and I was able to make a comparative calibration, but quite good results can be obtained by trial and error, choosing a suitable day, and subject, and using the meter with

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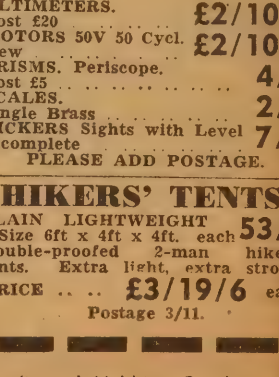

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llank scale, marking same as one p gresses.

As well as the design which Mr. El describes above there are one o two possible variations which ny be incorporated in a unit using t same standard parts. Some of t se suggestions may interest r ders who care to experiment.

OUR COMMENTS

n place of tinned steel or brass f the case, it would appear that aminium is also a very suitable terial, being light in weight, non-r gnetic, and easy to work. The y objection is that it cannot be dered, but those amateur mech-cs who have a little experience in eting will not find this an objec-n.

f the meter movement resistance not marked on the face, do not empt to measure it directly with regular ohmmeter. The simplest ocedure is to connect the meter to measured in series with a 1.5 lt cell, a .05 meg. potentiometer d another meter capable of a use-reading at about 70 microamps. e second meter movement in your licator would serve the purpose.

Adjust the potentiometer for full-le deflection of the meter to be asured and note the reading of checking meter. Now shunt the st meter with say a 5000 ohm tentiometer and adjust it to shunt meter back to about half-scale flection. This will affect the total rrent through the network slightly, read on the checking meter and ll necessitate an adjustment to the st potentiometer to keep the cur-nt constant.

The ultimate aim is to have the rrent through the network at its iginal value and the meter under st shunted to read exactly half ale. When this has been achieved, e shunting potentiometer can be moved and measured on an ohm-eter. Its resistance will equal the sistance of your meter.

GHT FLAP

An alternative and seemingly pre-rred method of varying the sen-ivity is to fit a flap over the front the cell, this being fitted with a mber of small holes or slots the tal area of which is a known frac-on of the cell area normally ex-osed to light. By making this a -to-one ratio, a single scale on the eter can be made to serve for both nges.

The flap should be hinged so that can be readily swung in front of e cell or removed as required and me form of small hinge may need be bought or made to fasten it the main case.

The scheme has the advantage at the cell continues to work into e same load and its "law" is not any way effected, while the need r series and parallel resistors, metimes of non-standard values, is voided.

A further refinement, for those ho are really keen, is to fit a set adjustable scales to permit direct lculation of the exposure for arious combinations of film speed, ns aperture, &c. In commercial struments this is done by calibrat-g the meter in light units of some nd (this calibration may be purely bitrary) and then using a small disc lculator to translate this informa-tion into actual exposure informa-tion.

Normally four scales are provided, two on each half of the disc and two around its edge on the case. These would be: Light values (corresponding to the values on the meter scale), stop numbers, film speeds and shutter speeds.

A convenient combination is to locate the shutter speeds opposite the film speeds and the stop numbers opposite the light values. This allows the film speed to be set against the shutter speed as a semi-permanent adjustment, thus allowing the correct stop number to be read directly against the light value. However, there is no reason why other combinations should not be used if desired.

MORE DIFFICULT TASK

Although the above arrangement makes the instrument more versatile there is the disadvantage that it is not quite as easy to use as the original design, assuming that the latter is used with the combination of film and stop opening for which it is calibrated. There is also the point that the preparation of the various scales may present a problem in some cases.

Summing up, we may say that there is plenty of room for experiment in the construction of devices of this kind, but that Mr. Bell's description provides an excellent basic design for those who either wish to build something similar or are keen to tackle something more complicated. After all, half the fun obtained from devices of this kind is in their construction.

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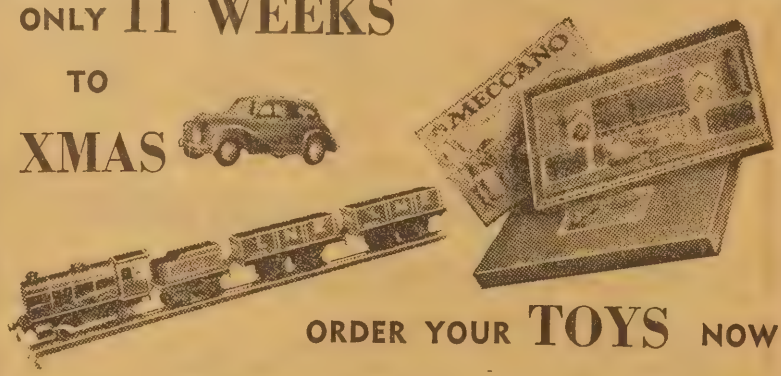

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ANSWERS TO CORRESPONDENTS

R.G. (Bayswater, WA) says he has built the "Little General" for 1951 with amazing results and now wants to build it into a suitable cabinet and use it as a tablegram.

A.: The "Little General" is not ideal for use as a tablegram because it has insufficient audio gain for pickup work. With 78 rpm records it was formerly possible to feed a crystal pickup into the grid circuit of a power valve and obtain satisfactory results but the present position is not so simple. Modern crystal pickups give rather lower output than the earlier types, and it is even lower when playing a microgroove record. The pickup you have does, however, appear to have above average output and it may just be satisfactory. You would have to instal a switch to disconnect the "hot" end of the volume control from the I.F. transformer and connect it instead to the active lead from the pickup. The other pickup lead would be grounded. It would be wise also to wire say a 1-meg resistor permanently from the bottom of the IFT2 secondary to earth so as not to leave the AVC circuit open when the volume control is switched across to the pickup function. If the radio signals tend to play through it might be necessary, as in the conventional radiogram, to have a second pole of the switch shorting the aerial or breaking the screen supply to the I.F. amplifier.

N.V.M. (Brighton East, Vic.) submits a suggestion for users of quick-heating soldering irons.

A.: Many thanks for your letter N.V.M. We will make use of your suggestion at the first opportunity.

M.G.S. (Yallourn, Vic.) has bought a 3-speed record player but finds that it suffers from rumble and motor noise. He wonders whether it would help to mount the turntable and pickup on a steel plate and raise this off the motor board with pads of sponge rubber.

A.: This treatment is usually very helpful. A steel plate will do, or a piece of ply at least ¼in thick. We have found small springs rather better than sponge rubber although the latter is simpler to arrange. You could also try connecting about a 60-watt lamp in series with the power lead to the motor to reduce the operating voltage. We have tried both schemes with considerable success.

L.C. (Junee, NSW) is having trouble lining the short wave section of a receiver, being troubled with pulling effects and double spot problems.

A.: The pulling effect which you observe between the aerial and oscillator circuits is quite normal, though some sets are more prone to this effect than others. The normal procedure is to retune the set continuously as the aerial trimmer is adjusted and, although this may seem difficult, it can be done with a little practice. The reason you are obtaining stronger signals on the low frequency double spot is probably due to the aerial circuit being tuned to this spot rather than the correct (high frequency) spot. This in turn is probably due to incorrect setting of the iron core in the aerial coil. Adjusting this core at the low frequency end of the band while tuned to a signal should enable you to select the correct setting.

C.G. (Balladoran, NSW) forwards an ohm-meter circuit for the measurement of very low resistances and will possibly include another device for the "Reader Built It" section of the magazine at a later date.

A.: Thanks, C.G., for your interesting letter. Your present circuit could well be of value to other readers and we are holding it with a possible view to publishing it in some future issue.

M.P. (Boyanup, WA) wants to know the type of coils used in a certain commercial portable receiver. He also asks the gauge of a piece of enamelled wire enclosed and whether April, 1953 Radio and Hobbies is still in print.

A.: We regret M.P., that our files do not cover information concerning commercial receivers and are unable to help you with your query on the coils used. Comparing the piece of wire with the wires we have on hand at the present, it would appear that its gauge is in the order of 22 SWG. Issues of Radio and Hobbies for April, 1953 are out of print, M.P. Odd copies of back issues are sometimes returned to the office from various sources and become available through the query service and, if you care to write in enclosing the usual fee, we will endeavour to locate one for you.

M.B.T. (Lithgow, NSW) has obtained some old copies of Radio and Hobbies and is intrigued by the circuit of a one valve set in one of them. He wants to know where he can obtain a cl to suit this set.

A. Unfortunately, M.B.T., you ne ed to tell us the date of the parti issue you have on hand, making it ficult for us to advise you. If th was one for which a ready-made cl was described this should be ava from most of our advertisers, pa larly those specialising in kit sets. some cases we have suggested that ers construct their own chassis, in v case all the necessary dimensions have been included in the article. you care to let us have further d of the issue involved we may be to assist you further.

P.R. (Lakemba, NSW) sends us a cuit and details of a piece of simple gear which he has built and whic thinks may be of interest to readers.

A. Many thanks for your contribu P.R. and we are passing your lette to the "Reader Built It" section for sible inclusion at a later date.

E.W. (Bendigo, Vic.) writes to in whether we can advise him how to ob greater sensitivity from his Se Portable.

A. From what you say it appears your set is not giving the same formance as the original which capable of about the best perform one would expect from this numbe valves. The problem is really one a serviceman who can investigate performance in terms of sensitivity the various stages, such as the IF ch nel, RF stage, &c., in order to deter just what is at fault. Lack of sensiti at the high frequency end of the could be due to mis-alignment of of the stages which would be indic by failure of one of the trimmers peak correctly. The loop aerial is likely to give trouble in this reg It is most unwise to reverse the nections to the filament battery this will upset the bias arrangem and greatly increase the battery dr However, the fact that this is poss without causing instability would s to suggest that the gain is lower t it should be. We have never publis a trouble shooting chart in Radio Hobbies, but will keep the idea in m for possible use at a future date.

R.W.H. (Evandale, Tasmania) asks s questions about rectifiers for an power supply which he is planning use with a 5in C.R.O.

A. Your reference is correct. maximum rating for the EY51 i mA when feeding into a maximum f capacitance of .1 mfd. The minim resistance in the series circuit of transformer secondary, the rectifier the first filter capacitance is .1 mego The 6X2 is electrically similar to EY51. The 1B3GT has a maxim average rating of 2 mA but this filament type of 1.25 volt .2A ra which may be less convenient to than the 6.3V .090A rating of EY51/6X2. Details of the K2/100 s nium rectifier are maximum input v age 2400 rms, the maximum output rent 5 mA. The output voltage u these conditions across a maxim capacitance value of .5 mfd is 2800 v This means that it would be a sa factory substitution for the AV11 in R & H 5in CRO circuit.

T.P.A (Vic.) has written enclo 6/6 for blueprints, circuit, &c., omitted to mention his address. If will supply this, we will send the formation required.

N.C. (Faulconbridge, NSW) encl the circuit of a 2 valve regenerative ceiver with the suggestion that it be of interest for the Reader Buil page.

A. Many thanks for your interest, We cannot make any promise about p lishing your circuit but we will plac in our files for possible considerati a later date.

THE "RADIO & HOBBIES" QUERY SERVICE

ALL queries concerning "R & H," designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to others readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 4/6. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO, Sydney.

Note that "RADIO & HOBBIES" does not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

C. (Melbourne, Vic.) asks a num-
f questions regarding radio terms
ractice as well as one about a 1000
cillator.

lmost any valve would operate
oscillator at 1000 Kc if employed
uitable circuit. Such a circuit was
bed in Radio and Hobbies, for
ry, 1951, and is available through
iery service. The letters "IF" are
breviation of the term "intermediate
ncy", or the frequency to which
coming signals are changed in a
eterodyne receiver. Most of the
type valves had the grid pin
ht out the top of the envelope
nimise capacitive coupling to other
Modern valve design now per-
single-ended construction without
ignificant increase in this effect.
in connections may be ascertained
ference to valve data books which
available from the various valve
facturers, either gratis or for a few
gs. The frequency of an oscil-
circuit is determined by the
of inductance and capacitance
n the tuned circuit. Varying either
vary the generated frequency.

. (Ingleburn, NSW) thanks us for
vious reply from the 2/- Query
e and asks about parts for the
egram".
Glad to know that we were able to
Chassis blueprints for the "Table-
are available at 4/6 each. The
s and components may not be
ard items with radio supply houses
but no doubt could be obtained
ler. The IF is 455 Kc and standard
and oscillator coils are used. We
ave a couple of copies of the June,
issue and can post one to you for
otal cost of 2/-.

R. (Kingswood, NSW) writes to en-
whether we intend carrying out
xperiments with the R & H Speaker
sure described in the May, 1953, issue
adio and Hobbies.
Without making any rash promises
s seem likely that we may do some-
along these lines, particularly if
gh of our readers seem interested.
the original article the scheme cer-
did seem to offer a number of
ntages and it would be interesting
e if they could be substantiated in
practice. Many thanks for your kind remarks about the magazine and we are glad to hear that you are having so much success with the Playmaster.

R.W.H. (Evandale, Tas.) has bought an ex-disposals radar display unit and wants to know something about the components.

A. We are not completely familiar with all the variations and part numbers but we would expect the filament transformer you mention to be a high freqency type —probably 500 cps. If so, it would be of no use whatever for 50-cycle operation. It is usual for cathode-ray tubes to require somewhat different setting of the controls for the same brilliance and focus but your second tube appears to be suspiciously non-standard. You could try raising or lowering the potential on the focus control but, if it still has no effect whatever, we would be inclined to think that the tube is faulty. The intensity control will have some effect also on focus.

D.W. (East St. Kilda, Vic.) queries the circuit and wiring diagrams of the 1953 Little Jim and suggests that there is a discrepancy between them.

A. We have checked these drawings again very carefully D.W., and we can find no fault as you suggest. It seems likely that you have misread the wiring diagram and confused another .01 meg resistor as a .01 mfd capacitor. This is one difficulty with wiring diagrams and is why we encourage readers to work from the circuit diagram whenever possible. We suggest you check it over again D.W., in the light of the above suggestion, when we feel sure you will be able to work it out.

L.A.C. (Nutgrove, Qld.) forwards a transmitter and VFO circuit for comment.

A. As far as we can ascertain with a quick check, there are no serious faults in your transmitter design. It would be desirable to connect a 50 ohm resistor in series with one of the key contacts to slow the discharge of the click filter condenser. For correct operation, the VR150 should have a current of between 5 and 30 mA passing through it in which case the voltage across its terminals will be very close to 150. However, before the tube will "strike", 150V has to be applied. The Acos Mic 3 has two terminals, one of which is connected to the metal case as well as one side of the crystal element. This terminal is marked with an "E" and should be connected to the outside sheath of the microphone cable. The wrong connection will probably result in hum and instability. We cannot make a definite promise about describing a VFO in Radio & Hobbies but you can rest assured that we have the matter well in mind.

N.S. (Dunkeld, NSW) has built the Reinartz Portable and is having a little trouble receiving stations at both ends of the band.

A. Assuming that you used the same value of tuning capacitor as was used in the original set, you should have no difficulty in covering the broadcast band. However, we think it likely that the gang you used (you do not mention what type it is) was smaller than the usual value, thus limiting the tuning range. It is likely that in your location you are getting reasonable results from the set as a portable. You can probably reduce the strength of your local station considerably by the use of a wave trap. This consists of a parallel tuned circuit, capable of tuning to the frequency of the offending station, and connected in series with the aerial. The grid winding from an ordinary broadcast coil tuned by a standard tuning capacitor would be a suitable combination. In use it is adjusted until the strength of the station is reduced to a minimum.

B.F.S. (Putaruru, NZ) asks about an RF choke for the 3-valve portable described in the March, 1953, issue and also if a .0005 mfd variable condenser is okay for the set.

A. An RF choke having an inductance of 2 mH or greater and wound in three or more sections would be suitable. Experiment has shown that the cheaper chokes wound in a single section are usually unsuitable due to their high shunt capacity. The tuning condenser will be in order and will give greater coverage at the low frequency end of the range. If you wish to use the original chassis layout it would be wise to check the physical dimensions of your condenser.

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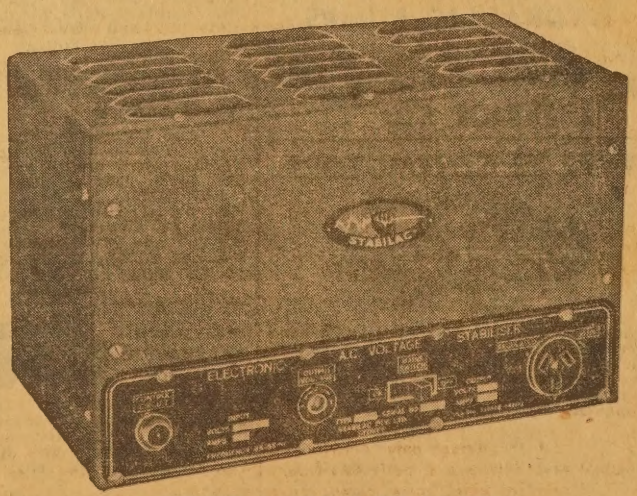

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6F6	12/6	VR150.30	22/6
6K6G	12/6		
6K7	10/6	2050	22/6
6K7G	10/6	(This valve is suitable for use in photo-cell relay unit as per R & H June issue.)	
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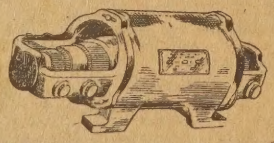

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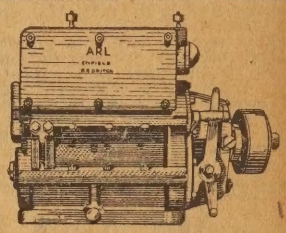

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AN EASILY MADE ENGRAVING TOOL

ny readers have, no doubt, found the need to put their name on tal and plastic objects permanently and yet neatly. A small engraver rking off a transformer seemed to be the answer to this problem, at least for casual use.

BY G. N. LARSSON

D results can be obtained using n engraver running off a 6-volt former, although the impression e harder metals is not very deep. will be seen from the illustra- the frame consists of two ¼in nium rods bolted together at ends. The top of each rod is d to take the screws for fixing erminal strip.

out 2in from the top each rod ed flat so that the magnet can mly clamped in position. The n of the top bolt, which tightens hole frame, depends on the size e magnet, but it should be about

e magnet used was taken from nt-out milliammeter. was found that the magnet was ate from the pole pieces and these were retained they were fied slightly. Th magnet was removed and then the poles were so that their faces were plane lel instead of circular. tually, any magnet will do, but is to be fairly strong, and the ier it is the less cumbersome be the finished instrument. e magnet is clamped in the e, as no attempt should be made ill it, so that it could be bolted, e heat and vibration produced d cause quite an appreciable in its strength.

AINING STRIP

brass strip can be soldered across gap on each side of the pole es. These strips stop the arma- from falling out from between poles.

a magnet is used that has no rate poles it would be better to p one long strip all round the net rather than solder on to it.

e armature consists of an elec- magnet mounted on a rod that voted loosely on the bottom pole he frame.

ne pole of the electro-magnet ex- ls beyond the coil and lies loosely veen the poles of the permanent net. The coil is connected directly he transformer.

n electro-magnet taken from an tric bell will answer the pur- , although if it has a solid iron this should be replaced by a inated one. The laminated core made up of several pieces of ed iron wire.

o make the core cut the wire to right length, i.e., the length of coil, plus length of the pole ex- ding into the space between the es of the permanent magnet.

ive each wire a coating of shellac then allow them to dry. Force many of these pieces of wire into coil until the whole core is tight rigid.

he method of mounting on the will depend upon the type of coil used. The method used by the writer is shown in Fig. 2. The laminated core is not pushed right to the end of the bobbin and a bolt is screwed into the space left.

A hole is drilled lengthways into the bolt and the rod soldered into it.

The armature pivots on the bottom bolt of the frame which passes through a hole in the armature rod. As the vibrations are at right-angles to the normal movement that would be allowed by the pivot, the hole through the rod has to be a little larger than the diameter of the bolt.

To keep the rod in position while still letting it vibrate, a pad of sponge rubber is placed on either side, between it and the frame.

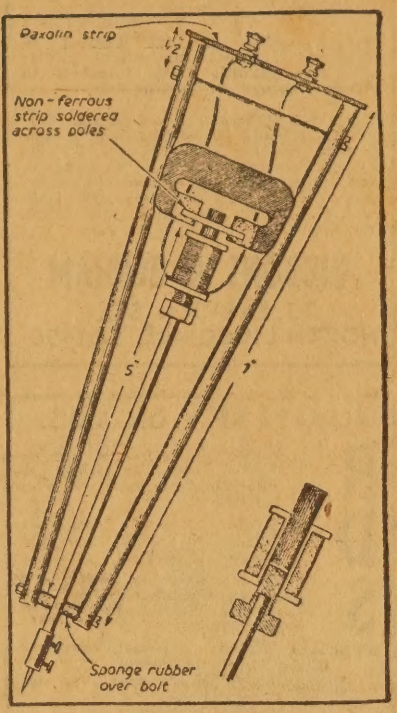

Figure 1 (left)—a general view of the complete engraving tool. Figure 2 (lower right)—a section of the coil showing the method of mounting.

The needle should be fastened as near to the pivot as possible. One of the easiest ways of doing this is to fasten a wire connector to the rod, the needle being clamped into the connector by a milled-head screw. A gramophone needle is quite satisfactory for the job.

To get a good impression on the metal, i.e., using a 6-volt transformer, the writer found that the coil was inclined to get rather hot. The current was therefore measured and found to be just over 2 amps.

If the coil heats up excessively, it may be necessary to reduce the applied voltage or to rewind the coil to include more turns of wire. The penetrating force behind the needle is largely determined by the amount of current flowing and the number of turns on the coil.

TELEVISION 3-DIMENSION PROBLEM

(Continued from Page 21)

is maintained between the views seen by the two eyes.

Actually there are still viewing zones in which the spectator gets the "inverted" stereoscopic effect, but these have a small angular width compared with the correct viewing zones.

A method of applying this optical principle to television has been proposed. Instead of the photographic camera moving around the subject, it has six lens-systems, arranged in an arc, which focus their respective views through slotted masks on to a translucent screen.

The screen displays a composite picture of six interlaced views. This is scanned from the other side by a television camera and transmitted to the CRT screen, where a slotted mask is used to give the stereoscopic effect.

Again the scheme could be operated with an existing television system, but would not be "compatible". Its worst drawback is that it reduces the definition of the picture: the transmitted information is shared between six interlaced views and consequently each view has only one-sixth of the information that would be present in an ordinary television picture.

It is obvious that the total number of view elements in the composite picture could not be greater than the horizontal definition of the television system. On the British television system this means that there could not be more than about 500 of them, and the slotted mask would only have about 85 vertical slots in it, and would appear as a very coarse grating.

Actually, the slotted masks are not at all good things to use in practice because they introduce considerable loss of light. The same job can be done, however, by lenticular screens made of transparent plastic, and it is actually these that are used in most of the three-dimensional shop-window displays.

The plastic sheet has one surface pressed into extremely fine corrugations, and each corrugation constitutes a tiny lens which performs the same function as a slot in the mask. Such screens can be made very cheaply and would only add a few shillings to the cost.

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Cost of Classified advertisements in this section is 2/- per line, approximately five words to a line. Closing date for November issue of Radio and Hobbies is Wednesday, October 14.

FOR SALE: Offer wanted RCA AR88D Comm. Receiver; S meter, 100KC marker Xtal. Sell Taylor Signal Gen., 100 Kc — 23 Mc., as new, £16. University Signal Tracer, as new £12. Transceiver 3-7 megs with pwr. supply inc. genemotor, £12. VCT Valve & Circuit tester, £20 Xtals — Bliley variable 7169 Kc £2; 1000 Kc, 30/-; 50.330 Mc, 30/-. Pr. new 809's, £2 each. Radiotron Designers Handbook new, £2. **VK 5 OD, Box 73 Port Pirie, South Australia.**

FOR SALE: High fidelity gear, Byer motor M.B.H. 12in pick-up ML20 amplifier in maple cabinet. Axiom 150 in vented enclosure. **JM2524 evenings.**

SELL: Patents, stock of business. Making telephone amplifier device approx. £1800. Write, **Plowman, 188 Hampton St., Hampton, S.7., Vic. XW2686.**

SELL: Oxy-welding outfit complete. Good. **Adams, 2 Martin Av., Botany.**

SELL: Supertester, m/meters (new), variable condensers (new) and many parts many R. & H., Radio books, ¼in electric drill. Also axle assembly 16in wheels 5ft 4in track. Apply **45 Bunnerong Rd. (tram to Nine Ways), Kingsford.**

SELL: Genmotor 26v. in 550v 3 out 26v in 250v, 100ma out, £ two. Converter 24v DC in 240v, 50cyc out £5. 102 **Gloucester Hurstville.**

SELL: Dynacord microphone 42M Decca FFFR unit complete sap head, £6. Garrard D15 motor, £2. Dy speakers from 15/-, also valves, coils **c/o King, Albert St., Corowa, NSW**

SELL: Williamson 60 watt output former. Fully terminated. W on Eng. Electric C. Core, £18. Gaur **27 Pope Rd., Blackburn, Melb. WX**

SELL: A.R.B. Receiver 195-905 Control Box, Cables, Instru Manual — less valves, £5 — Transfo 230v Primary Secondary-300-0-300V MA. 3500V 500MA, 4V, 24.5A, 4V, 4000V insulation, 2V CT 1.5A, 6.3V £2/10/-. **Adams, 93 Williams St., bourne. MU7195.**

WANTED: R. & H. Playmaster M and Control unit No. 2 or parts same). **1 Hampden St., Dubbo.**

WANTED: M.17 telescope elbow army. **2 Martin Av., Botany. FA**

WANTED for all your problems turning, drilling, threading etc. **XY1900 outside business hours.**

LET'S BUY AN ARGUMENT

(Continued from Page 61)

It all boils down to whether engineers can make reactivators which are sufficiently foolproof in the first place and able to yield to the general public enough return in £ s d to justify their existence.

And, of course, it involves the battery manufacturers also. They can treat the whole subject with "ignore", or they can investigate further the design of cells specifically intended for reactivation. There might be very interesting possibilities in this direction.

Once upon a time there was a vast gulf between accumulators and primary cells, but the introduction of "dry" accumulators and the recharging of dry cells has reduced it to much smaller proportions. So much for that subject.

My reference last month to overseas designs and ideas brought forth a rather unexpected comment on American 110-volt power lines. The letter makes interesting reading, however, and has been printed in full.

Our correspondent paints a glowing picture of conditions in the US and makes one wonder whether it's indeed an electronic Utopia or whether there's another side to the picture. (An open invitation to anti-American or other disgruntled types).

Certainly Australian authorities cannot match their US counterparts in what must be a most impressive display of pole transformers. Perhaps they're glad they don't have to!

On the other hand, they do freely pipe 415-volt 3-phase lines into plenty of homes for cooking and heating purposes, which matches the US effort of making available extra voltage for heavy loads.

The lack of earthing, too, can be regarded as a mixed blessing. It saves home "handymen" from making wrong connections, but it saves nobody when the appliance itself develops an internal fault.

As for the idea of "floating" chassis in a transformerless set, well aware of its advantages disabilities, particularly the lat

At one stage in my existenc had to build and service a lot AC/DC sets for people in the Syd city area—at a time when su mains were being changed over f DC to AC. Maybe that's where prejudice began.

It was a lovely feeling to k that a certain set would go int situation where the active main negative with respect to earth; the receiver would operate for whole of its existence with cha and "earthy" circuits alive by volts.

We tried floating the entire cuit free of the chassis and w a job it was in those days w paper condensers were unreli and electrolytics all came in la aluminium cans. And how th sets used to hum on AC ma when tuned to a station!

As I said last month, a lot these schemes work well enough 110 volts, but not at 240.

But I still don't like the i brought to our notice by a rea a couple of weeks back—a transf merless electrocardiograph. merely laid the patient out on table and coupled him up to el trodes, making ultimate and rat intimate connection to the mains. did not concede to his request a 240-volt version of the dev Not for home construction anywa

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